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Replacing the Bowler Hat

For generations, the insignia of office for the foreman was the bowler hat. It has long been out of fashion, but nothing has quite replaced it. Yet the foreman holds a key position in industry. The acquisition of a high-grade foreman minimizes the problem of youth recruitment, and irons out the difficulties of management. Obviously, the prime requisite of any supervisor or foreman is that he shall have the innate gift of leadership, without which real success will not attend his efforts. If this gift be present, then it is well worthwhile giving some thought as to how his efficiency can be increased. This subject has recently had the attention of a committee of inquiry established by the Ministry of Labour and National Service and a Report* has been issued.

The first statement of importance is that industry requires well over 10,000 new supervisors each year, and thought is given to their training both internally and extra-murally. Internally, there are available the excellent "training within industry" system, the local technical college, and various association courses and activities. Some large firms possess their own organizations for the purpose of training foremen. For the medium and small-sized concerns, reliance is placed on organized lecture courses and here it is interesting to learn that "rather less emphasis" is being placed upon "management or industrial psychology." After all, as we pointed out initially, unless a foreman has the gift for leadership—that is, he is a born psychologist—no amount of training will make him one. Rightly, more stress is being placed upon such activities as report writing and public speaking. To have full effect, the management must take an equal interest with the foreman in any course and its later effect upon the efficiency of the shop.

Just as the efficient foreman reduces the recruitment of youth into an industry to a minimum, so does enlightened management ensure that promotion to foremanship can be effected with a maximum of efficiency. There should be no waiting until a vacancy arises, before consideration is given to the problems which will then arise. If there is apparently nobody available for promotion, then steps should be taken to repair the omission in conjunction with the existing foreman. These, of course, will vary in every individual case, but it is not an insoluble problem. The Report does set out the training facilities available throughout the country, but this is but one method only. For instance, in certain cases, it is best to envisage one foreman taking over two sections, with the appointment of one or more assistants. The permutations are innumerable, yet the main factor to have in mind is a set plan. The Report is certainly worth study, especially for the larger concerns, but there are so very many facets to industry that each firm must supply its own solution. The purchase of a bowler hat is totally inadequate under to-day's conditions.

* *The Training of Supervisors.* Published by Her Majesty's Stationery Office, York House, Kingsway, London, W.C.2. Price 2s. net.

JAMES EDGAR HURST, C.B.E., D.Met., J.P.

Deputy chairman and managing director of Bradley and Foster Limited

Leaders of the Industry

DR. J. E. HURST

FEW metallurgists are better known than Dr. Hurst, deputy chairman and managing director of Bradley and Foster Limited, a director of the Staveley Coal & Iron Company, Limited, Tilghman's Patent Sand Blast Company, Limited and George Richards and Company, Limited. The special fields of activity in which he has achieved an international reputation are those of centrifugal casting and alloy cast iron. In the latter sphere he has devoted much attention to surface hardening by nitrogen and the occurrence of gases in the metal.

He has had a long association with the Institute of British Foundrymen, which he joined in 1914 and was (national) president in 1935, after having presided over the Sheffield branch. In 1933, he was the recipient of the Oliver Stubbs Gold Medal and in 1938 the E. J. Fox Gold Medal. During his association with the Institute he has delivered a series of papers dealing with cast iron, starting in 1930.

Dr. Hurst has also presided over the Staffordshire Iron and Steel Institute. His association with the Iron and Steel Institute dates from 1916; he was a Carnegie Research Scholar in 1917 and a member of Council from 1944 to 1949. The proceedings of this Institute contain many contributions from his pen. He was a Founder Fellow of the Institution of Metallurgists and from 1944 to 1949 served on its Council.

Another distinction held by Dr. Hurst is that he was the first president of the National Trades Technical Societies' being also a life member. He has given yeoman service to the British Cast Iron Research Association over which he presided in 1950-1952, and his work in this field has been recognized by his being made a Commander of the Order of the British Empire and by honorary membership of the Association. Other technical activities include membership of Council of the Sheffield University, from which body he received the degree of D. Met. (*honoris causa*); presidency of the Institute of Vitreous Enamellers; membership of the Board of Governors of the National Foundry College; membership of the Institution of Mechanical Engineers and Council membership of the Federation of British Industries, Midland Region.

It would be excusable for such a busy man if he confined his activities purely to technical pursuits, yet he has many local interests in Lichfield, where he is a magistrate, a sheriff, chairman of the Johnson Society, a high constable, and an honorary freeman of the Worshipful Company of Smiths. He is also a liveryman of the Worshipful Company of Founders. For distraction he takes a great interest in literature and sport.

Forty Years Ago

Our issue of August, 1914—the month war broke out—is very interesting, as the leading article abstracts the Census of Production for 1911. This document states that in the ironfounding industry, 102,573 (322 women) were employed. To-day according to the Council of Ironfoundry Associations there are 130,238 (9,589 women). At that time, however, the statistics did not include the stove-grate trade which employed 10,261 (442 females), so the increase has not been astronomical. The figures were broken down to show 57,065 moulders and core-makers; 30,666 labourers; 8,526 fettlers, 2,506 cupola and oven men and 3,750 undefined people. The second "Leader" deals with the Factory Report for 1913 then only a seven months delay. The Report referred to might very well serve for 1954 as there is the same urge for foot protection by means of safety boots and spats; for better pathways; for the reduction of the dust hazard. It is to be hoped that it will not take another forty years before these problems are resolved. The issue continues with a description of the Atlas Foundry at Armadale; conveying systems in the foundry and machinery for the treatment of sands and moulding materials. It is this last article which reveals the great progress that has been made. Finally, there is an article "Aluminium Foundry Notes." The "trade notes" have, unfortunately, not been bound in the volume available to the reviewer.

Conference Paper Author

MR. F. A. WOOLLEY, whose Paper "Design and Operation of a Modified Cupola" (presented at the Glasgow Conference of the Institute of British Foundrymen) is printed in this issue, was educated at Smethwick (day) Technical College, and Birmingham Central Technical College. He joined the Midland Motor Cylinder Company, Limited in 1926 as laboratory assistant, rising progressively until, in 1941, he was appointed chief chemist and metallurgist. He became an associate member of the Institute of British Foundrymen in 1931 and a full member in 1944. In 1951 Mr. Woolley was elected an associate of the Institution of Metallurgists. He has studied automobile foundry practice during visits to both the United States and to the Continent.

"I.B.F. Golfing Society"

Entries are coming in well for this year's meeting on October 1 and 2, and the Society is already assured of a good party. Members are reminded that the closing date for receiving entries is August 31, and with the holiday season in full swing, there is always a chance of forms being mislaid or forgotten. The hon. secretary, Mr. P. G. Pennington, Tees Foundries Limited, Tees Ironworks, Middlesbrough, will be pleased if those intending to join the Woodhall meeting will take immediate action.

Stone-Chance Limited Changes

New directors have been appointed to the Boards of Austinlite Limited and Sumo Pumps Limited, the two English subsidiaries of Stone-Chance Limited, a new company incorporated on May 27, 1954, and itself a subsidiary of J. Stone & Company (Holdings) Limited. Stone-Chance Limited was formed to take over the engineering interests of Chance Brothers Limited, after their purchase by J. Stone & Company (Holdings) Limited.

The directors of Austinlite Limited are now Mr. John Raymond, Mr. F. W. G. Beaumont, Mr. L. B. H. Hallett and Mr. N. A. W. Stacey, and the directors of Sumo Pumps Limited, Mr. John Raymond, Mr. T. O. Orr, Mr. F. W. G. Beaumont, Mr. L. B. H. Hallett and Mr. N. A. W. Stacey. All except Mr. John Raymond are new directors appointed from the management of the companies. Mr. Raymond, who is managing director of Stone-Chance Limited, has been on the Board of these subsidiary companies for the past ten years. The other directors of Stone-Chance Limited are Mr. Bryan Preston (chairman), Mr. A. J. S. Brown and Mr. P. A. Peterson.

Iron and Steel Institute

The twenty-sixth meeting of the Iron and Steel Engineers' Group of the Iron and Steel Institute will be held in Newcastle-on-Tyne from September 13 to 16.

The meeting will be devoted to the presentation and discussion of seven papers on the developments at Consett works given by various members of the staff of the Consett Iron Company, Limited, followed by visits to the works at Consett and Jarrow and to the ore-discharge terminal at Tyne Improvement Commissioners Quay. The visit to the ore-discharge terminal at Tyne Dock is by kind permission of the Tyne Improvement Commission. As the maximum number of people who can be accommodated on the works visits and in the hotels in Newcastle is approximately 150, members who wish to attend are advised to apply as soon as possible.

Balances Calibrated in "Newtons"

To meet the needs of universities, technical colleges and professional institutions, particularly those concerned with electrical science, spring balances calibrated in "Newtons" are now being supplied by Geo. Salter & Company, Limited, of West Bromwich. The Newton is a unit which was adopted by the International Electrical Technical Commission in 1950 and which has since been recommended by the Institution of Electrical Engineers for use in universities and technical colleges. The difference between the pound (or kilogramme) and the Newton is that the former is a unit of mass, whereas the latter is a unit of force, including acceleration due to gravity. One Newton equals 0.2247 lb.; 1lb. is the equivalent of 4.4503 Newtons, and a kilogramme equals 9.81 Newtons.

International Foundry Congress

Visitors to the forthcoming International Foundry Congress, September 19 to 26, may receive their private correspondence at the following address:—21ST CONGRESSO INTERNAZIONALE DI FONDERIA, Piazza della Libertà, Firenze Italy. They also may receive cables addressed: Confound—Firenze. The telephone numbers of the Congress are: 50.143 and 50.175.

Design and Operation of a Modified Cupola*

by F. A. Woolley, A.I.M.

The normal cupola furnace as used for the continuous melting of high-duty grey iron for the manufacture of automobile castings, has been modifid by providing auxiliary heating to the contents of the well by the application of electric power. This additional heating, being independent of the main source of heat developed in the melting zone of the furnace, is used to correct any irregularities that may arise in that zone during the normal blow, that are reflected in a lowering of temperature or a loss of fluidity in the metal being tapped. The quantity of heat applied to the well is determined by the input of power, which in turn is controlled by means of a suitably-designed transformer. The low-voltage, high-amperage electric current from the transformer is led through the walls of the well by means of carbon electrodes, so arranged that they project horizontally a short way into the coke contained in the well, which is thus made to serve as a kind of resistor.

Besides providing a convenient and rapid method of temperature control, the experience gained suggests that the additional heating so applied has important effects upon both the composition and the casting properties of the metal tapped. The indications are that chemically-reducing reactions between oxides that collect in the slag, and the excess of carbon present in the coke, are stimulated, and slags low in iron oxides result. Metal under such slags shows a reduced tendency to "throw" chill, and appears to be able to yield a greater pick-up of carbon. With heavy input of power, evidence of a positive increment in silicon has been obtained. The use of this modified cupola has been found to improve the service of metal to the pouring stations in the foundry, and to widen the range of raw materials that it has been possible to utilize at times when the supply of these materials has been a major problem.

Towards the end of 1947, the late Professor Piwowarsky published a cupola furnace design[1], in which he proposed to convert the well into an electrical induction furnace with the object of producing metal of more uniform composition and of obtaining greater control over the tapping temperature. In a subsequent paper,[2] results were published of work on a 4-tons-per-hour furnace together with details of the design of the necessary electrical equipment.

This work was of particular interest to the present author, since in some respects it ran parallel with a modified cupola[3] that had been designed in connection with an experimental programme carried out towards the end of the last war, not—be it said—using induction heating, but rather a form of resistance heating of the well and its contents. This experimental programme was designed to test the possibilities of conserving supplies of silicon, by attempting chemical reduction of the element from SiO_2 normally present in the slag. The results of these experiments are briefly referred to in a later section, but it was soon realized that apart from the primary object indicated above, the auxiliary heating of the well by electrical means could most likely yield results of considerable value as a control mechanism when applied to furnaces engaged on ordinary day-to-day production.

The following notes therefore give an outline of the design and operation of a modified cupola furnace that has been worked out in the foundries of a large manufacturer of motor cylinder castings, and which has proved to be of considerable assistance in overcoming some of the difficulties presented by the post-war shortages of raw materials. It was to provide a method of minimizing these difficulties that the development of production-scale modifications was put in hand. This involved the conversion of the lower part of the cupolas into resistance units by inserting electrodes horizontally through the walls of the well, by means of which a heavy electric current could be introduced, and passed against the resistance of the coke and slag contained therein. By this means a source of heat was provided that, being independent of the heat generated in the normal melting zone higher up the furnace, could be used to correct any irregularities that may develop in that zone. The quantity of heat so provided to be controlled by varying the power input through a suitably-designed transformer.

The first battery of cupolas to be modified in this manner went into regular production in 1948, and since then has been in daily use. The cupolas have a 6-tons-per-hour melting rate and have a power input equal to 30 kwh per ton of metal melted. This is sufficient to provide a fair measure of control over the metal temperature but it is thought that a greater rate of power input would be more advantageous. With the accumulation of experience on these furnaces, it was decided to extend the auxiliary heating to the cupolas in a second foundry, these went into production early in 1953, and have an 8-tons-per-hour melting rate and have a power input of some 60 kwh per ton melted.

Production Considerations

These cupolas have been installed in foundries engaged in the manufacture of automobile castings.

* Presented at the Glasgow conference of the Institute of British Foundrymen.

Design and Operation of a Modified Cupola

It will be recognized that for the successful manufacture of this class of light-section, heavily-cored work, the provision of a constant supply of metal, correct as to composition and of adequate fluidity, is a fundamental requisite. This is particularly so where continuous casting on highly mechanized plants is the practice. With moulding, core-setting, closing, and pouring organized into a tightly integrated sequence of operations, the failure of any one may lead to serious delay and loss of output. Metallurgical considerations require that the composition of the iron should be standardized on a low-phosphorus, medium-carbon type of material, so that the maintenance of satisfactory properties at the pouring stations depends essentially on keeping adequate temperature in the metal. Under such conditions of standardized composition, the close relationship between fluidity and temperature has been stressed by Clark,[4] and more recently by Porter and Rosenthal,[5] among the many workers who have explored the possibilities of the fluidity test spiral. The first objective, then, is to ensure that the metal sent to the pouring stations is sufficiently hot to run the lightest section of the work in hand, and that there should be no interruption of the supply.

For meeting the requirements of the foundries concerned, the cupola furnace is the only one that can be employed. Its major advantages in the way of economy and flexibility of operation, its simplicity of construction and maintenance, and above all the continuous nature of its operation, preclude the use of any other type. This continuity, however, makes it extremely sensitive to a large number of variables, so that in order that proper control over the melting operation may be exercised, a large measure of standardization both of the materials entering the furnace and the furnace technique itself is required. Unlike the output of furnaces of the batch type, the products from cupola melting are not the result of the attainment of a stable state of thermal and chemical equilibrium, but rather are determined by a number of opposing influences and reactions, none of which has time to proceed to completion. Both oxidation and reduction occur at various levels in the cupola, but in normal practice the net effect is one of oxidation, as shown by the loss of silicon and manganese from the metal. The second objective is to try to offset this oxidation by stimulating reducing reactions in the furnace well.

Maintaining Consistency

Whereas the standardization of melting technique is an internal matter, and is therefore under the control of the operator, this is not the case with the raw materials constituting the charge—coke, scrap, pig-iron, etc.—which as materials purchased externally are subject to all the complications that may arise in the supply situation. During the years following the end of the war (a period when demand for castings has risen to exceptionally high levels) considerable difficulty has been caused by shortages of these materials, especially of cupola coke. In the foundries with which the writer is associated, anxiety has been experiencd at times when supplies of the customary brands have not been available in the quantities required, so that recourse has had to be made to substitutes from other ovens, sometimes from different parts of the country. This question of consistency of coke supplies is found to be of the greatest importance in maintaining regular and uniform metal from the cupola.

It may not be that the alternative brands are in themselves inferior, but that having different properties from the brand for which the furnace is burdened, they require a modification of the melting process that cannot always be made in the time available. With three, and sometimes four kinds of coke arriving on the charging floor in rapid succession, control to the degree required becomes almost impossible. It is true to say that of all the variables affecting the operation of the cupola, the quality of the fuel is perhaps the most important single factor, since its characteristics in relation to the particular practice concerned exert a profound influence upon both the composition and the temperature of the metal tapped from the furnace.

Due to the effort of the coke manufacturers, it is recognized that the current position shows a great improvement on the difficult times of 1947-50. Nevertheless, the furnaces fitted with the modification to be described have been of considerable assistance in removing fluctuations in the metal from this cause.

Theoretical Considerations

Before proceeding to a more detailed account of the actual furnaces, it is proposed to refer briefly to some of the considerations envisaged when the modification was proposed, in particular to some of the chemical reactions involved. As has already been indicated, the original target was to conserve silicon, so that it was thought that with a slag normally containing around 45 per cent. SiO_2, present in the well in contact with an excess of carbon in the bed coke, chemical reduction should be possible, provided that the correct conditions could be established. Normal cupola melting does not provide these conditions, since a loss in silicon from the metal is expected and is allowed for in calculating a charge mixture. To explain this loss, attention was directed to the thermal conditions prevailing and it was concluded that since the reaction between SiO_2 and carbon is strongly endothermic, it could only proceed at an appreciable rate if sufficient thermal energy was available to maintain the necessarily high temperature required. Given this energy, it was expected that liberation of elemental silicon would occur and that its absorption in the metal would be reflected by its composition.

However, it was also recognized that this could not happen when other, more-easily-reducible oxides, especially FeO, were present in the slag. This directed attention to the upper parts of the furnace where these oxides originate. While the chemical reactions at the various levels of the cupola have been summarized by Fleming[6] in a paper before the 1953 I.B.F. conference, a few of

the more important may be recalled as examples bearing upon the particular subject under discussion:—

(*a*) In the shaft of the furnace, the descending charge is passing through an atmosphere rich in CO, so that at the appropriate temperatures reducing reactions between the gas and oxides of iron on the surface of the pig-iron and scrap in the charge take place. Any such oxides that are not reduced pass down to the well and increase the content in the slag. It is probable that this source of oxide only becomes of importance when badly "burnt" scrap is being melted, and "fiery" metal, lower in carbon and silicon, results.

At the same time, an opposing reaction between CO_2 (also present in the gases) and carbon in the charge coke is also taking place, and re-forming CO, with the absorption of a considerable quantity of heat. This combustion of coke in the upper levels of the furnace is thought to have an important effect upon the bed height, particularly when fuels of different reactivity have to be used. Thus, if a furnace is melting normally, using a charge coke of low reactivity, and suddenly it has to be changed over to use a coke of higher reactivity, then unless a change in the proportions of the charge coke is made, sooner or later a fall in the bed height will occur and be reflected in the condition of the metal at the taphole.

(*b*) In the zone opposite to the tuyeres, *i.e.* below the zone of fusion, the metal in the form of drops (and therefore presenting a large surface area) is exposed to an atmosphere containing an excess of unconsumed oxygen and CO_2, where, because of the high temperature, rapid oxidation can take place. Normally, the degree to which this oxidation occurs is limited by the very short time that the metal drops remain in this atmosphere. If, however, because of low bed height, or the presence of excessively weighty pieces of high-melting-point material (*e.g.* steel scrap) in the charge, solid metal should be held in this zone, then the time interval will be prolonged and severe oxidation can occur.

(*c*) Finally, in the well of the furnace the slag and metal separate into their respective layers, in the presence of the excess of carbon constituting the bed coke. The supernatant slag thus forms a blanket in which oxides formed at the higher levels collect, and through which the succeeding drops of metal have to percolate before they collect in the well of the furnace. If conditions are such that the FeO content of the slag is high, then the ability of the slag to absorb further quantities is lessened, and at the same time the losses of those elements capable of displacing iron from its oxide, *e.g.* manganese and silicon, will be increased. The depth of the slag layer is also important, since not only can reaction take place at the main slag/metal interface, but also around the surface of all the metal droplets as they sink through it. The deeper the slag blanket, the longer is the time available for these reactions to take place, and while the loss of silicon is reflected in the composition of the metal the increment in the iron is negligible.

Heating Benefits

However, on the basic assumption on which the experimental work was based—*i.e.*, that given sufficient thermal energy the reducing power of the carbon in the bed coke could be so stimulated that it would become a predominant reducing agent—then, it was concluded that the auxiliary heating would prevent the build-up of FeO in the slag and the losses of the more valuable constituents of the metal would be reduced. Carried still further, it is suggested that when the FeO content is reduced to very low levels, then the next most-readily-reduced oxide is open to attack and the experimental programme was proposed to test if this process could be continued until active liberation of silicon was obtained.

To determine how far this process could be carried, a small, 15-cwt.-per-hour cupola-type furnace was constructed with provision for auxiliary heating of the well by electrical means, as being the obvious method of providing the additional heat without the oxidation inseparable from the introduction of air. This experimental furnace was operated with a blast pressure of 2 oz., a coke/metal ratio of 14 per cent. and an electrical input equal to 300 kwh per ton of metal melted. Under these conditions, a silicon increment of as much as 1.0 per cent. was obtainable, so that with charges consisting of steel scrap as the sole metallic constituent, metal was tapped from the furnace which solidified with a grey fracture.

Apart, however, from this the primary object of the experiments, it was soon noted that the supplementary heating produced other effects that were thought to be of more immediate benefit to everyday production, yet with power inputs considerably lower than that indicated. These were summarized as follow:—

(*a*) Given sufficient thermal energy, the overall oxidizing conditions characteristic of normal cupola practice can be neutralized or even replaced by chemical reduction.

(*b*) The additional source of heating, being independent of the melting conditions higher up the furnace, could be used as a balancing agent to correct any irregularities that might arise during the blow, at least for the time necessary for more permanent measures to become operative.

(*c*) Conditions favourable to the reduction of oxides also appear to favour the absorption of carbon into the metal.

(*d*) These influences together increase the flexibility of the cupola and the auxiliary heating can be used to improve the control over the melting operation or to widen the range of raw materials that can be used in the charge.

It was upon these conclusions that the decision to proceed with the construction of production scale furnaces was taken, and a description of one of the installations follows.

Furnace Design

The layout of the 8-tons-per-hour furnaces is shown in Fig. 1 taken from an arrangement drawing of the two cupolas constituting the installation in

Design and Operation of a Modified Cupola

one of the foundries, showing the general position of the furnaces in relation to the electrical gear. The cupolas are of conventional design with internal dimensions proportioned to give the required melting rate. On the left is the sub-station containing the 520 kva transformer and the switch gear to the high tension mains supply. The transformer is of the off-load tap-changing type, designed to give six tappings in five-volt steps, between 25 and 50 v. From the low-tension side of the transformer, bus-bars carry the current in its respective phases across the rear of the cupolas, to a pair of isolating switches, one to each furnace. These are essential so that the standing furnace is completely isolated from the power supply whilst fettling operations are in progress. That is, the furnace in blast is switched in so that power can be applied at any time required. At the same time, the second furnace is switched out and thus completely isolated, whilst the fettling crew is carrying out repairs in preparation for the following blow. Each of the isolating switches and its corresponding cupola can therefore be considered as a unit.

From the switch, further bus-bars carry the power to three water-cooled electrode holders mounted on, but electrically insulated from the cupola shell. This insulation is a comparatively easy matter in view of the low voltage employed. The positioning of these bus-bars in relation to the cupola is shown in Fig. 2, an illustration of the back of the furnace. This shows the main bus-bars running overhead from which the tappings to the electrode holders are taken. It will be observed that these are well out of the way of the operators working at the site. This illustration also shows the position of the rear electrode holder in relation to the tuyeres and the slag hole. The electrode is arranged at such a height that its lower side is level with the slag hole, so that when the slag is up to that height the carbon is partially immersed in it.

The location of the other two electrode holders is shown in Fig. 3, which is a front view of the furnace, illustrating also the taphole and launder. The three holders are in fact disposed at 120 deg. to each other around the cupola shell, and at 60 deg. on either side of the taphole. Again, it will be observed that the front of the furnace is quite clear of obstruction, and that the furnace-man is in no way impeded by the presence of the electrical equipment.

Fig. 4 is a close-up of one of the electrode holders, containing a carbon electrode, in the end of which is a threaded jointing piece. From the upper side of the holder, two vertical pipes carry the cooling water which is continuously circulated to prevent overheating, and behind these pipes the bus-bar connection can be seen.

Other Layout Details

The carbon electrodes are 6 in. dia. and are obtained in 24- and 36-in. lengths. By means of the threaded jointing pieces they can be continuously extended as they shorten in use so that wastage is kept to a minimum. It should be noted that while the furnace is in blast the electrodes are immovably sealed into the furnace wall. There is no question of feeding them in during the blow, but since the loss of carbon is at most a few inches per day, the shortening that does occur has no influence upon the effectiveness of the set-up. Indeed it is believed that the actual loss of electrode carbon during the operation of the furnace is very slight (since the end inside the furnace is surrounded by the bed coke) and that most of the shortening that does occur takes place after the furnace bottom is dropped, when the uprush of air inside the red-hot furnace causes a certain amount of combustion of the hot carbon electrodes.

In fixing the electrodes in position, they are so arranged that they project a distance of approximately 10 in. from the lining into the well, and are clamped in this position by tightening their holders. They are then sealed tightly into the brickwork with ganister, so that there is no opportunity for the blast to leak around them during the subsequent blowing.

Cooling water is circulated through the holders throughout the whole of the working day, but due to the bulk of water maintained in a storage tank its rise in temperature is hardly perceptible. Both the tank and the pump providing the circulating water are conveniently mounted on the charging platform, also out of the way of the furnace crew. Although quite a large amount of auxiliary

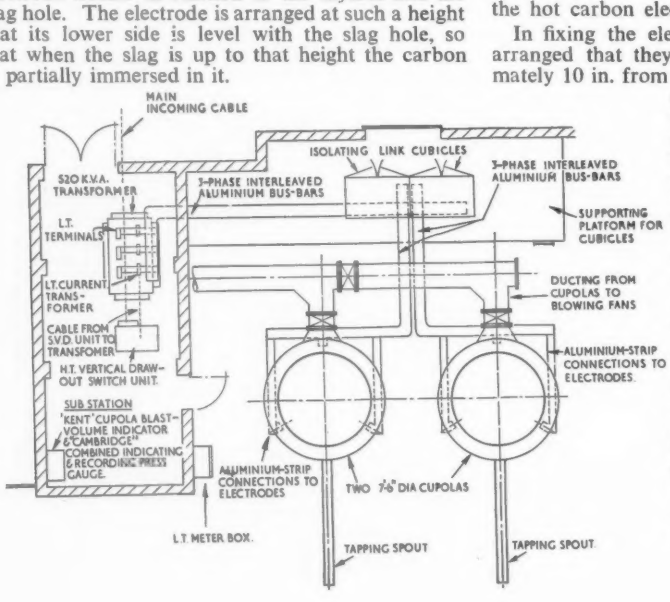
MAIN INCOMING CABLE
ISOLATING LINK CUBICLES
3-PHASE INTERLEAVED ALUMINIUM BUS-BARS
520 K.V.A. TRANSFORMER
3-PHASE INTERLEAVED ALUMINIUM BUS-BARS
SUPPORTING PLATFORM FOR CUBICLES
L.T. TERMINALS
L.T. CURRENT TRANS-FORMER
DUCTING FROM CUPOLAS TO BLOWING FANS
CABLE FROM S.V.D. UNIT TO TRANSFORMER
H.T. VERTICAL DRAW-OUT SWITCH UNIT
ALUMINIUM-STRIP CONNECTIONS TO ELECTRODES
SUB STATION
"KENT" CUPOLA BLAST-VOLUME INDICATOR & "CAMBRIDGE" COMBINED INDICATING & RECORDING PRESS GAUGE
ALUMINIUM-STRIP CONNECTIONS TO ELECTRODES
TWO 7'-6" DIA CUPOLAS
L.T. METER BOX
TAPPING SPOUT
TAPPING SPOUT

FIG. 1.—*Arrangement of Equipment and bus-bars for the electrification of cupolas.*

FIG. 2.—*Electrode at the rear of the cupola modified for electrical heating, shown in relation to the slaghole and one of the tuyeres.*

apparatus has thus been assembled around the cupola there is no congestion and the operators proceed with their duties in the usual manner.

A system of interlocking keys is used to protect both the transformer and the isolating switches from possible damage. These make it impossible to alter the tapping on the former, or enter the cubicle of the latter while they are on load. As has been indicated, they are of the off-load type, so that the circuit has to be broken before changes can be made. The keys are retained in the possession of the metallurgist in charge of the furnaces and at whose discretion the power is used. The on-off switch is mounted on the meter board, which also carries instruments showing the voltage applied and the amperage passing on each of the three phases. These are in full view of the furnace-man who is thus kept fully conversant with the electrical side of the job.

Operating Factors

In all other respects, the furnaces are of conventional design and are operated in the usual manner with intermittent tapping of metal and periodical removal of slag from the rear slag-hole. The depth of the well is sufficient to allow the retention of two ladles of metal, that is, approximately two tons, below the level of the electrodes. It will be noted that the electrodes are not immersed in the metal, but penetrate into the coke contained in the well in which the heat is generated. As the metal drops through this zone of superheated coke at the level of the electrodes, its temperature is raised and the effect of the auxiliary heating rapidly becomes diffused throughout the volume of the well. The method of heat generation appears to be partly by means of the resistance of the actual pieces of coke, and also by a series of small arcs where the individual pieces contact each other.

From the chemical aspect, an important feature of this method of heating is that it is brought about without the introduction of air and is therefore devoid of any oxidation effects. From the thermal point of view it will be seen that, since the heat is generated actually inside the cupola well the bottom and sides of which are enclosed in insulating refractory, a very large proportion of it is available either for raising the temperature of the metal or for stimulating chemical reactions. Heat losses which are unavoidable when metal is tapped and transferred to a second container or receiver are thus avoided.

The resistance of the contents of the well is not constant at all times during the blow, so that control of the power input in kwh is obtained by the operator selecting the tapping on the transformer to give an applied voltage appropriate to the input required. It is not possible, therefore, to quote the input available when blowing, but under static conditions (*i.e.*, with the furnace stand-

TABLE I.—*Range of Power Available with the Furnace as Charged (with metal in the well, but with the wind off).*

Transformer tapping.	Voltage.	Ammeter reading.
No. 1	25	2,700
No. 2	30	3,000
No. 3	35	3,400
No. 4	40	4,000
No. 5	45	4,600
No. 6	50	5,000

FIG. 3.—*Front of the furnaces showing the meter board (left) and the electrodes on both sides of the tap-hole.*

FIG. 4.—*Close-up view of the electrode holder built into the furnace showing the bus-bar connection, cooling-water pipes and the protruding end of one electrode.*

ing fully charged and with metal in the well, but with the wind off) the basic range of the equipment is shown in Table I. With the blast on, and melted metal dropping down to collect in the well, the amperage passing at the selected voltage rises rapidly, so that for temperature adjustments during ordinary melting the higher voltages are seldom required. Indeed, for such purposes, the 30-volt tapping, which gives an average input of some 200 kwh, or the 35-volt tapping which gives an average of 300 kwh, is found to be the most suitable. At the selected voltage, the ammeter reading rises directly as the metal level in the well rises between taps so that a good indication as to how much metal is being carried in the well can be obtained by a glance at the meter board.

Method of Working

The intention is to use the power as a correcting agent to the normal cupola operation, so that its use is therefore intermittent. It is only used when the condition of the metal requires it, or when it is known that conditions conducive to "cold" metal are to be expected. The actual method of working a cupola fitted with this modification is therefore as follows:—

With the furnace fettled in the normal manner, and the electrodes sealed in position, the fire is laid ready for ignition at about 3.30 a.m. so that it is well burnt up by the time that the furnace crew arrive for duty in the morning. If for any reason the fire is slow in burning up, an application of electrical power is made to accelerate combustion. With a good fire, the cupola breast hole is made up, the bed height checked, and the furnace charged. The transformer tapping is adjusted to the 35- or 40-volt mark and the power switched in for some 15 min. before blowing is commenced. With melting under way, observation of the control board may indicate that the transformer tapping should be dropped to a lower voltage, and at the appropriate time the taphole is opened. Usually, two half-ladles are taken off and pigged and then with metal at a suitable temperature for despatch to the pouring stations, casting commences. The use of the power in this manner ensures a prompt start to the day's melting, and after the tapping of the second or third casting ladle the power is switched off.

The tapping on the transformer is then reduced to the 30-volt setting, if this has not already been done, since at this value minor adjustment of the metal temperature can be made by simply switching in the power for the duration of a couple of taps and then taking it off again. In the event of more difficult conditions developing, possibly shown by a hardening of the metal, more prolonged application at a higher rate of input is made to restore normal melting. It is, of course, desirable to take such corrective measures as early as possible, since the more abnormal the conditions the greater the amount of power consumed, or the longer the time required for the measures to become effective. During the time that the power is applied, the metallurgist in charge of melting is able to check over the practice and to make such adjustments as may be necessary and when these have taken effect the power is taken off.

Results Secured

By this means, casting is maintained without interruption and any metal likely to be doubtful as to temperature or chilling tendency is corrected during the course of the melt. In the event of the blast being taken off, as, for example, during the lunch-time break, the power is switched in for the duration of two or three taps before melting is halted, so that additional heat is given to any metal that may have to lie in the well during the stoppage, making sure that this part of the furnace does not become unduly chilled. If the stoppage is prolonged or should come about without warning, the power is kept on while it lasts, and before blowing is re-started the well is drained, so that the first

TABLE II.—*Effect of the Auxiliary Heating on the Temperature of the Metal Tapped.*

Ladle.	Time.	kwh used.	Metal temperature, deg. C.
	11.18	Power on	
No. 1	11.22	15	1,450
No. 2	11.29	36	1,450
No. 3	11.36	63	1,460
No. 4	11.43	80	1,480
No. 5	11.50	110	1,490
No. 6	11.59	140	1,495

metal down will have the extra temperature derived from the electrical source.

The effect of the auxiliary heating in terms of temperature is shown in Table II, which are the results of determinations in the foundry using a Pt/Pt.-Rh immersion thermocouple and a quick-acting indicator. At the commencement of the test recorded, the cupola was melting normally, and the power was turned off when it was thought that the metal was becoming excessively hot. Each tap was of approximately 1 ton of metal, so that in a period of 45 mins. from power-on, and with a consumption of 140 units of electricity, it was possible to raise the tapping temperature by 45 deg. C. without any slackening of the melting rate or alteration of the charge proportions. The normal tapping temperature in the foundry concerned, determined in the same manner, is between 1430 and 1460 deg. C., and metal at temperatures below 1400 deg. C. would be regarded with suspicion.

During such an application of the electrical power, the first effect to be noted is a reduction in the quantity of sparks thrown off as the metal streams into the ladle during tapping. Parallel with this quietening of the metal, the amount of smoke rising increases and the metal brightens up. With still more input of power the chill shown by wedge test tends to fall and the carbon and silicon contents tend slightly to rise, although it is recognised that at the power levels suitable for temperature adjustment, changes in composition are necessarily small.

The degree to which the composition of the metal is affected appears to depend upon both the quantity of power applied and upon the conditions in the well at the time of the application. Finally, it is found that the use of the auxiliary heating in the manner described has no practical effect upon the consumption of refractories and certainly no increase in the labour force has been required to carry out the small amount of additional work entailed in the setting of the electrodes.

Conclusions

A method of applying auxiliary heating to the well of the cupola has been developed which, after several years of service under production conditions, has proved to be quite a practical tool, and which has been used to smooth out any irregularities that occur during melting. This has been found not only to improve the supply of molten metal to the pouring stations, but also to widen the range of raw materials that could be utilized in the furnace. This has been made possible by reason that the modified furnace has provided the metallurgist in charge of the melting operation with a method by which he can apply a short-term corrective measure so that casting can continue without interruption until more permanent adjustments to the practice become operative.

Apart from the reference from the German source mentioned at the beginning of this paper, it is thought that the method of auxiliary heating of the cupola well has only been used in the foundries on which the author has reported. In presenting these notes, therefore, it is in the hope that their submission to the Institute will result in comment and discussion from the wider standpoint of the industry as a whole.

It is emphasized that nothing approaching finality has been reached, indeed, under the production conditions indicated, the opportunities for experimental work are necessarily limited, and the provision of the equipment costly. Nevertheless, although the development to date has been along essentially practical lines, it is believed that sufficient has been done to indicate certain possibilities that are worth bringing to the attention of a wider audience.

Acknowledgments

The author wishes to place on record his indebtedness to the directors of the Midland Motor Cylinder Company, Limited, in whose foundries this work was carried out, for their permission to publish these notes; also, to all those members of the staff of that company in the metallurgical, engineering, and electrical departments, who by their assistance and co-operation have contributed so materially to the development and practical application of this modified cupola.

REFERENCES.

[1] E. Piwowarsky, "Induction Heated Cupola," *Iron Age*, Feb. 5, 1948, pp. 76-78.
[2] E. Piwowarsky, "Aachen Induction Cupola," *Die Neue Giesserei* Feb. 7 ,1950.
[3] British Patent No. 591,117, Aug. 1947.
[4] K. L. Clark, "Fluidity Testing of Foundry Alloys," *Proc.* Inst. Brit. Foundrymen, 1945-46. Paper No. 847.
[5] L. F. Porter and P. C. Rosenthal, "What the Fluidity Test Reveals," *Foundry*, Aug., 1953, pp. 94-99.
[6] D. Fleming, "Interaction of Combustion and Metallurgical Reactions in the Cupola," *Foundry Trade Journal*, Sept. 17 and 24, 953, pp. 349-357 and 401-405.

"Operation Seraphim"

"Operation Seraphim" was completed at Scunthorpe on July 29, when "Queen Victoria," the biggest blast-furnace in Europe was lit by Sir Archibald Forbes, chairman of the Iron and Steel Board. A silver paper-weight, specially made and engraved by Walker and Hall Ltd., of Sheffield, was used as the press-button and started off the sinter plant half a mile away. The paper-weight was afterwards presented to Sir Archibald as a memento of the occasion.

The new furnace is 28 ft. 6 ins. in diameter—18 in. more than "Queen Anne," which was blown in by Sir Walter Benton Jones, chairman of the United Steel Corporation in March. This had been planned to produce 6,000 tons of pig iron a week, but for the week ending July 24 produced 7,390 tons. The two furnaces will add 600,000 tons a year to production which goes to Samuel Fox Ltd., of Stocksbridge, and Steel, Peech and Tozer, of Rotherham.

Latest Foundry Statistics

According to the Council of Ironfounding Associations employment in the ironfounding industry for the week ending May 29 was 130,238 males and 9,589 females making a total of 139,827 respectively as against 130,530; 9,645 and 140,175 for the week ending May 1.

Rating and Valuation

By F. J. Tebbutt

Before the war, general "valuations" as regards rating for local purposes were held every five years both for outside London and inner London, but the coming of the 1939-45 war stopped these quinquennial sequences, war-time legislation suspending any general valuations until conditions were considered more favourable. However, with the end of hostilities, a new Act on rating etc., was decided on, and the Local Government Act 1948, was passed, which with other matters, included the important provisions taking the making of valuations from the local authorities, and transferring it to the Commissioners of Inland Revenue, valuation officers of that body officiating.

1948 and 1952 Acts

Furthermore, rating procedure is to apply the same for inner London and outside London, but the *first* valuation will apply for outside London from April 1 and for inner London from April 6. The 1948 Act laid down dates for the coming into force of the new "Valuation Lists," 1952 being the first date mentioned for both inner and outside London, but the lists were not ready, so 1953 became the date, and then 1954, but still further postponement was necessary, the lists still not being fully prepared, and this time the 1948 Act could not cover further postponement, so a new Act was required for this purpose, namely the "New Valuation Lists (Postponement) Act 1952." By this Act the Minister of Housing & Local Government is given power to direct by Order that the Local Government Act 1948 (subsections (1) and (2) of section 34, the provisions concerned with the dates for new valuation lists) can apply to such later dates as may be specified.

Under this 1952 Act, there have been two Orders (the first in force December 29, 1952) making 1955 the year of operation for the first valuation lists, only for the second one (March 12, 1954) to put off the date until 1956, the actual date for outside London being April 1, 1956 and for inner London April 6, 1956. Incidentally after this first general valuation, the lists are—whether for inner London or for outside London—to apply from April 1 in each case, the next valuation lists to apply in the year 1961 and then each subsequent fifth year.

A point of substance is that although the Inland Revenue (by the 1948 Act) now functions for valuations, and not the local authorities, the procedure of assessing (except as regards dwelling houses—see later) is the same as before, since the 1948 Act provides that nothing in it is to affect the principles to be followed in making valuations as laid down in former Acts (*e.g.*, 1925; 1929 Acts, etc.). As this method is being used for business and similar premises in this valuation, the following are given as showing how rateable value is obtained. The term "gross value" means the rent at which a hereditament might reasonably be expected to let from year to year, if the tenant undertook to pay all usual tenant's rates and taxes and if the landlord undertakes to bear the cost of repairs and insurance and the other expenses, if any, necessary to maintain the hereditament in a state to command that rent. Off the gross value, an amount for repairs (there are statutory allowances scheduled) comes, leaving "net annual value" which is the rateable value. For factories, etc., in most cases "net annual value" usually applies, as ordinarily, the tenant pays for repairs. Special provision was made in the 1948 Act for new valuations of dwelling houses, but this new system did not turn out satisfactorily, for in many instances the old houses emerged from the tests of the proposed procedure with proportionately higher assessments than the newer ones—which was not intended.

Consequently, this system has been scrapped, and assessments for the new valuation lists will be made under the provisions introduced by another new Act, the "Valuation for Rating Act, 1953."

1953 Act

Valuations are to be equal to the rent at which the hereditament in question might reasonably have been expected, on or about June 30, 1939, to be let from year to year, under the conditions previously specified. If the rent payable to landlord is inclusive of rates, etc., it might be added that the amount of these would be deducted to arrive at the rent relevant to the Act. For the foregoing provisions to apply, it will be assumed that the hereditament was subsisting on or about the date mentioned (*i.e.*, June 30, 1939) in the state in which it actually subsists at the time of valuation. Furthermore, it will be assumed that the circumstances as regards the locality, transport services, and other facilities available, and as respects other matters affecting the amenities of the locality are similar to what obtains at the time of valuation. If it be assumed that there have been changes in the circumstances of the locality since 1939, as, for example, perhaps, a change from being rural in 1939, to now having more factories and houses there, the valuer can estimate what the rental values of houses would have been if the factories and houses had been there in 1939, and for this purpose he could use his knowledge of similar places. It is claimed that there is enough evidence of rents in the 1938-39 period to enable both pre-1919 houses and post-1918 houses to be assessed on 1939 rental levels. Notwithstanding the general formula, a departure from this can be made where rents as at June 30, 1939, may be unduly low or unduly high in relation to the ordinary run of rents in the locality. Broadly, valuations in these cases can be estimated to bring them into line with what prevailed in the free market of 1939. By free market is meant that while there was a large area of controlled houses round about that date, there were many at that date decontrolled (*i.e.*, a free market), the new control came afterwards.

Provision is made for the assessment to be made at the "gross value" procedure (and not under the 1939 method) in cases where the property is not readily lettable or as easy to let as in 1939—a "white elephant" as it were—so that its current rental value is lower than the 1939 value. All the appurtenances of a house, its garden, yard, sheds, court, forecourt, and garage, which together with a house count as a single rateable hereditament, will be lumped in with the house, the whole property assessed on 1939 values. Storage premises for a household and other articles of domestic use as well as light vehicles come under the term "private storage premises" and are assessed on 1939 values. This provision covers such premises as those foregoing, if used wholly in connection with a dwelling house or houses, even though not part of them.

Special provision is made as regards premises used partly as a dwelling house, etc., and partly for other purposes (*e.g.*, business and similar purposes), so that the dwelling-house portion (the gross value assumed as in the older Acts must be considered to be at least one tenth of the whole assessment) comes under the new provisions of this 1953 Act (1939 values), and the business portion under the older provisions (gross and net annual values) on current values. Such hereditaments would be assessed together in most cases as one hereditament, of course.

Centrifugal Die-casting in Rubber Moulds*

Methods Suitable for Loco-melting-point Alloys

Tin-base alloys are excellent materials for die-casting on account of their low melting point, high fluidity and pleasing appearance. The casting temperatures are so low that low-carbon steel dies can be used almost indefinitely without deterioration but, nevertheless, die costs can be high if intricate shapes be required, especially for limited production runs. For this reason, the development of rubber dies in conjunction with a simple centrifugal casting process has materially reduced the cost of tin-base die-castings and gives a practical process with many potential uses requiring only limited outlay and technical resources.

The process has already found extensive application for the manufacture of costume jewellery and there seems no reason why it cannot be developed to produce small intricate castings for other purposes.

The moulds are normally made from discs of synthetic rubber about 9 or 12 in. dia. and 1 in. thick. Two unvulcanized discs, fitted into steel rings, are used for a mould. The upper surface of the lower disc is dusted with French chalk and a ring of patterns placed on it. The patterns may be of any material which will stand the vulcanizing temperature and pressure and as many are used as the available space will allow. Three or four registering devices are also inserted and the top rubber disc put on. The two discs are then placed between the platens of an electrically-heated vulcanizing press and raised to the vulcanizing temperature recommended by the rubber suppliers. When the rubber is sufficiently warm to become plastic, gentle pressure is applied and gradually increased over a period of five to ten minutes as the rubber flows around the patterns. Finally a pressure of about 10 to 15 tons for a mould 9 in. dia. is

* Reprinted by permission of the Editor of *Tin and Its Uses*.

FIG. 1.—*Centrifugal casting machine, with thermostatically controlled melting pot and (right) examples of finished castings.* *(Courtesy of N. Saunders)*

reached and maintained for from 20 to 30 minutes or as recommended by the rubber supplier.

The rubber is vulcanized while at this pressure and after cooling the die is removed from the press and the two halves parted and the patterns removed. The rubber is fully elastic and this allows the use of patterns with undercuts, because the rubber deforms as the pattern is removed and springs back to its original shape as soon as the pattern has gone. This property is also utilized while casting; complicated shapes may be cast in a two-part rubber mould which otherwise would require expensive multi-part metal moulds. The rubber takes a very fine impression from the pattern and this is transferred to the casting, if low-melting-point alloys of high fluidity are used.

Pouring

The necessary central pouring gate and channels to allow the metal to run into the mould cavities may be moulded in by attaching suitable wires to the patterns or they may be cut into the rubber with a sharp, wet knife after vulcanizing.

The finished moulds are poured on a centrifugal casting machine consisting of a motor-driven turntable revolving at speeds of between 500 and 1,200 r.p.m., depending on the diameter of the die. A suitable machine is shown in Fig. 1. The metal is melted in a thermostatically controlled pot, also shown. The lid of the casting machine is closed and the mould is set spinning. When the full speed is reached, a controlled amount of metal is transferred by a ladle to the central hole in the mould and is propelled into the mould cavities by centrifugal force. The motor is then stopped and the mould stripped and the ring of castings removed, complete with runners. After the runners have been clipped off by a pair of wire cutters the castings are ready for any finishing treatment that may be desired.

For costume jewellery and similar articles, the castings are often given a light burnishing by barrelling with small steel balls and finished by bright nickel plating. The thin coat of nickel increases the surface hardness of the castings considerably, so that even the weakest alloys have ample abrasion resistance.

Choice of Alloy

The choice of alloy for casting is restricted, because the rubber moulds deteriorate fairly quickly if the metal temperature exceeds 300 deg. C. when it comes into contact with the mould. If temperatures lower than 300 deg. C. are employed, the life of the mould is about 1,000 casts. The alloys found most suitable for this work are essentially tin with additions of antimony and copper to give increased strength and hardness. These alloys produce extremely sharp and bright castings of fair strength. Cheaper alloys such as 60:40 Sn/Pb or even certain type metals may be used, but some of these alloys lack the fluidity of tin and will not give

(*Continued at foot of col.* 2)

the same intricacy and sharpness of castings, and the moulds deteriorate more quickly. Typical finished castings are shown in the illustration.

The dimensional accuracy of the castings is good in the plane of the mould but dimensions perpendicular to the plane of the mould are very often reduced below those of the pattern.

The process provides a very convenient method for the production of small die-castings of intricate design, where the cost of plant and dies must be kept low and the sharpness and detail of the castings is important, but exact dimensional accuracy need not be achieved.

Publications Received

A Review of Productivity in the Pressed Metal Industry. Published by the British Productivity Council, 21, Tothill Street, London, S.W.1. Price 2s.

This industry has both sent and received productivity teams to and from America. This Report, after a reasonable interval of time since these visits, sets out firm by firm the progress which has been achieved.

"What Every Engineer should know about Rubber," by W. J. S. Naunton; published by the British Rubber Development Board, Market Buildings, Mark Lane, London, E.C.3; price 3s. 6d. post free.

This is an ideal book for informing the layman of the potentialities and drawbacks of rubber as a material for use by the engineer. Its 128 pages are divided into six chapters, and these quite logically cover the subject from the cultivation of the raw material to the testing and specifications of the finished product. The book could be improved by printing captions beneath the illustrations.

Accidents—How they happen and how to prevent them. July, 1954. Issued by the Factory Department, Ministry of Labour and National Service, and published by Her Majesty's Stationery Office, Kingsway, London, W.C.2. Price 1s. net.

The reading of these publications has the effect of broadening one's outlook on accidents. It is only natural for those in the foundry industry to think around mishaps due to the essential operations performed. Yet a foundry carries exactly the same general hazards as other industrial undertakings. An abstract from the Chief Inspector's report points out that of the 2,480 ladder accidents noted, there were 40 per cent. which were of the type that should not have happened. This issue carries an account of one foundry accident and suggests a better method of working.

Exporting to Canada. Published by the Board of Trade, through Her Majesty's Stationery Office, York House, Kingsway, London, W.C.2. Price 3s. net.

This is an excellent introduction to the whole business of selling to Canada. The great difficulties are clearly set out. Attention is called to the need for punctual delivery of goods, as the freezing-up of the St. Lawrence River can very easily convert a profitable business into a serious loss. America has many advantages in that not only do its magazines circulate freely in Canada, but she also benefits from commercial radio activities. Still, the more difficult the problem the greater the satisfaction in winning through, and in this connection this publication is most valuable.

Scumming of Enamels*

Final Report of Sub-committee of the Institute of Vitreous Enamellers

Members of Sub-committee:

Chairman: Dr. H. W. Webb (North Staffordshire Technical College).
Mr. W. E. Benton (S. Flavel & Co., Ltd.)
Mr. J. A. Clarke (Stocal Enamels, Ltd.)
Mr. A. G. Greenwell (Radiation, Ltd.)
Mr. S. E. A. Ryder (Stoves, Ltd.)
Secretary: Mr. A. W. Murdoch (Ferro Enamels, Ltd.)

Introduction

A Sub-committee to investigate the scumming of enamels was appointed by the Technical Committee of the Institute of Vitreous Enamellers in February, 1950, and an interim report† under the chairmanship of Mr. H. Laithwaite was presented at the annual conference, 1951.

Further Investigations

Following the presentation of the interim report, the sub-committee investigated and prepared summaries of the research literature on scumming, covering the associated industries of ceramics and glass, both of which contain useful information on the problem under discussion. These summaries are published with this report.

In their investigation, the sub-committee also took into consideration the paper on scumming and furnace atmospheres‡ presented at the 1949 annual conference by Mr. S. E. A. Ryder and Mr. G. W. Culshaw. In this report, for brevity, the sub-committee decided not to include details of the experimental results and the names of the individual members who were responsible for various pieces of work, but copies of these are in the Institute's files for reference should further investigations be sponsored at a later date.

General Considerations

It seemed that some of the practical points on which the Institute would need information would be:—

(1) Slurry conditions which might increase the tendency to scumming. In particular, the effect of the presence of soluble sulphates. The influence of clay and other factors which might affect the texture of the enamel and so make it more susceptible to moisture attack was also a point of possible importance.

(2) The influence of frit composition. So far as the base frit is concerned, there are clearly factors such as alkali : B_2O_3 ratio which might influence scumming; the relative susceptibility of frits which show greater solubility in water after grinding. Finally, the specific effect of particular oxides, including colouring oxides.

(3) The maximum SO_2 concentration in the furnace at which scumming did not occur, or if possible, a time/concentration at curve showing the time of exposure necessary at various concentrations of SO_2 to cause scumming.

(4) Similar data to (3) for the dryer.

Slurry Condition

Previous workers have proved that scumming of the fired enamel can result from absorption of sulphur oxides either in the dryer or in the furnace, or from sulphates introduced with the water used for the enamel suspension. In this connection the sub-committee has merely confirmed that the introduction of sufficient sulphates (either sodium or calcium sulphate) into an enamel suspension caused scumming in the fired product, the enamel being dried and fired under sulphur-free external conditions. In a particular series of observations 0.125 gm. of either sulphate per 100 ml. of mill liquor caused perceptible scumming, while 0.5 gm. led to severe scumming. The point was not investigated to get evidence that any of the three sources of sulphate mentioned above was the worst culprit in causing scumming, but to find an answer to certain obvious questions:—

(1) If the scumming results from an attack by SO_2 and oxygen on the surface of the enamel in the furnace, would it also occur if the sulphates were already disseminated through the enamel and it was fired in an electric furnace? The answer to this question is in the affirmative.

(2) This being so, the next obvious point was whether the soluble salt must be a sulphate. Here, experimental work showed that the addition of calcium chloride in amount four times the equivalent of the calcium sulphate which had caused severe scumming produced no signs of scumming under similar conditions. It can be inferred, therefore, that the mere presence of a salt in the enamel which is very soluble in water (and possibly hygroscopic), whether it be a sulphate or chloride, is not the sole cause of scumming. It will be remembered that the research abstracts from work done on this problem in other sections of the ceramic industry suggested that the "sulphuring" which led to scumming was essentially a surface attack. Since

* Presented at the Spring Conference, 1954, of the Institute of Vitreous Enamellers.
† Printed in the JOURNAL, November 1, 1951, and discussed December 6, 1951.
‡ JOURNAL, November 3, 1949.

the sub-committee are reasonably sure that some of the sulphates (especially sodium sulphate) present in the enamel before firing will be partly decomposed during firing, giving SO_2, they looked for the explanation here. When a sulphate-free enamel was suspended face downwards over a sulphate-loaded enamel $\frac{1}{8}$ in. away in an electric furnace, there were obvious signs of scumming on the upper plate. When it was $\frac{1}{2}$ in. away, no signs of scumming were observed.

These observations appear to the sub-committee to open up a line of work which might be fruitful, but which will obviously need specially-designed equipment, which may be outside the range of what a normal works laboratory in the industry could be expected to provide. One qualification must be added to all these observations, however —when dealing with a condition in which soluble sulphates are present in the mill liquor, a type of drying may subsequently be obtained where the bulk of sulphates is concentrated on the surfaces and edges of the test-plate, through the ordinary phenomena of drying. Further evidence on this point could be acquired if the effect of an insoluble sulphate such as barium sulphate were examined, but this has not yet been done.

Texture of Enamels

So far as the effect of the texture of the enamel is concerned, *i.e.*, the permeability after firing, very little has been done. Here again, a specialized field of work is being dealt with, which, experimentally, is rather difficult and not very suitable for the normal works laboratory. The replacement of the whole of the clay by Cellofas in an enamel gave conclusive results so far as tendency to scumming was concerned, but at the time this work was done there was no experimental equipment available to the member for obtaining controlled SO_2/O_2 concentrations under reasonably constant conditions. It is a matter of general observation that the white incrustation in scumming is most severe where the enamel is thin. There is some evidence that, when an enamel is not well melted, scumming may be more severe, and it is felt that the addition of refractory material, such as clay to the enamel, might well contribute to this condition. If this proved to be so, then it is quite possible that the fault known as "finger-marking" may fall into the same category.

Influence of Frit Composition

As a preliminary measure, 1.5 per cent. of each of the following colouring oxides was separately added to a standard base composition frit containing no other colouring oxides: cobalt, manganese, chromium copper, iron and nickel. Two separate observers found that the frit containing manganese oxide was the most susceptible to scumming, followed by that containing copper. In each of these cases, scumming was judged by loss of gloss, a method, incidentally, which is not always reliable where small differences are observed in darker-coloured enamels. A third series of observations was made in which the sulphate was extracted from the fired enamel and gravimetrically estimated. The results showed that, while the sulphate pick-up in the case of manganese and copper was appreciably higher than with iron, cobalt and nickel, the pick-up (and also the visible scumming) in the case of the frit containing chromium oxide was many times greater. This very surprising result needs to be confirmed. If it is proved, it is of great importance in relation to the scumming of black enamels. It has not been possible to do any work so far on the effect of the composition of the base frit, except the effect of the partial replacement of Ca by Zn mentioned below. There is a wide field of work on frit composition which might be helpful in relation to scumming.

In the "sulphuring" of ceramic glazes it has been proved that the presence of high proportions of calcium in the molecular recipe gave a greater tendency to scumming and, further, that if the calcium were replaced by zinc the scumming tendency was greatly reduced. Some tentative work on this point carried out by the sub-committee showed no difference between the two oxides.

Concentration of SO_2 in Furnace Atmosphere

To arrive at the objective of producing a curve showing SO_2 concentrations against time of exposure of sample, it was obviously necessary to have suitable experimental equipment for producing controlled atmospheres. This was not available to all members of the panel. In addition, it became clear that some other method of measuring scumming tendency than loss of gloss would need to be worked out, as it was not always reliable. The gravimetric determination of sulphate in the fired enamel is such a relatively long process that no member of the panel could expect to make much progress in investigations where the time available was necessarily very limited. The work and observations of the sub-committee have, therefore, been almost entirely limited to intermittent observations on production furnaces.

It should be pointed out that the SO_2 concentration in a typical muffle may arise partly from the decomposition of sulphates already present in the enamel before firing, and partly from diffusion and leakage through the furnace walls. The effect of both of these will depend to some extent on whether the atmosphere of the furnace is allowed to remain static (in which case, SO_2 concentration will build up) or whether it is adequately vented. It also occurred to the sub-committee that if the inside lining of the furnace were coated with a semi-refractory mixture which would sinter and render the surface reasonably gas tight, it would cut down a good deal of SO_2 diffusion from the flue gas. A mixture of equal parts of china clay and felspar proved quite effective for this purpose in the coal-fired furnace in which it was tried. So far as SO_2 proportions are concerned, one member reported that a concentration of 93 parts SO_2 per million caused slight scumming in a particular furnace (firing cast-iron enamel), while at 80 parts per million no scumming appeared.

In another range of observations taken on both gas-and oil-fired furnaces by a second member, a gas-fired furnace showing 153 parts SO_2 per million in the combustion chamber had only 1 part per million inside the furnace. An oil-fired furnace showing 600 to 1,000 parts SO_2 per million in the combustion chamber, showed only 4 parts per million inside the furnace. No sulphuring was obtained over the twelve months' observations in which these figures were obtained.

Dryers

No quantitative observations on scumming arising from dryer conditions have been undertaken. The SO_2 content of some gas-heated (Ballard) continuous dryers for sheet and cast iron was about 2 to 3 parts per million, and no signs of subsequent scumming were obtained under these conditions.

Summary

The sub-committee feels that this review of their discussions and experiments shows that there is a good deal of scientific work to be done on the exact mechanism of "sulphuring" followed by scumming; the influence of enamel composition and texture and the permissible concentrations of SO_2 in the furnace and dryer atmospheres. Many of the experimental techniques which would need to be developed would take more time (and possibly facilities) than are normally available to the man in industry.

SUMMARY OF RESEARCH LITERATURE RELATING TO SCUMMING IN CLAY AND GLAZED WARE

By convention, in ceramics, the term scumming is used when referring to the appearance of ware immediately after firing. The effect subsequently produced by wetting or the action of a damp atmosphere is called efflorescence. This difference should be borne in mind. Thus, clay products such as bricks may show white or yellowish surface marking or coating immediately after firing. This is known as scumming. On subsequent wetting and drying, the surface may show much increased deposits, and repeated wetting and drying increases this surface layer. Both effects are usually due to soluble salts (sulphates of calcium and magnesium) in the clay, but vanadium salts* (which occur in a number of clays) can give rise to a characteristic mustard-yellow efflorescence. When the phenomenon occurs with ceramic glazes, it is usually known as "sulphuring." Here again, the condition is observable immediately after firing, and subsequent wetting or exposure to a moist atmosphere has little effect in causing further loss of brilliancy. In severe cases of "sulphuring," a clear brilliant glaze may be transformed into a dull opaque layer, but normally the effect is one which occurs on the surface only. Frequently the layer of sulphates on the surface of the glaze forms well-shaped crystalline patterns; hence it is sometimes called starring and feathering, the crystal patterns resembling those of frost on a window pane. This has occasionally been used as a decorative effect on glazed pottery, but it is difficult to control.

* The vanadium content of light fuel oil (200 seconds) is about 0.004 per cent. by weight calculated as pentoxide. In the case of heavy fuel oil the weight content is about 0.007 per cent. calculated as pentoxide.

Sulphate Formation and Persistence

Factors influencing sulphate formation and persistence may be summarized as follow:—

1. The concentration of sulphur gases in the kiln atmosphere and in the atmosphere of the dryer before firing.
2. The presence of other gases and vapours in the kiln atmosphere.
3. The composition of the glaze or enamel.
4. Time and temperature of the reaction.
5. The presence of sulphates in the glaze or enamel through causes other than the direct action of sulphur oxides.
6. Stability of the sulphates produced.

These will be briefly reviewed.

The sulphur in a bed of solid fuel leaves the surface as sulphur dioxide, since the reactions $SO_3 + CO = SO_2 + CO_2$, and $2SO_3 + C = 2SO_2 + CO_2$ prevent the formation of SO_3. On the introduction of secondary air, the normal equilibrium $2SO_2 + O_2 = 2SO_3$ is set up, in which the SO_3 content is influenced by SO_2/O_2 concentration, the temperature, and the time taken for the equilibrium to be established. The maximum conversion occurs at about 450 deg. C., but the rate of establishment of the equilibrium increases with temperature. Since the reaction between SO_2 and O_2 is exothermic, the amount of SO_3 formed decreases with rise in temperature. It is well known, of course, that various catalysts accelerate the rate of formation of SO_3. Some of these may be present in certain circumstances, *e.g.*, Fe_2O_3, $MnSO_4$, Al_2O_3, and so on.

It is clearly established that oxygen must be present with the sulphur dioxide before sulphate formation can occur (H. Jebsen Marwedel, *Glastechnische Fabrikationsfehler*, Berlin, 1936 (72)), which suggests that the conditions most favourable for the formation of the maximum SO_3 content are likely to cause the greatest sulphuring (A. Faber, *Gas u Wasserfach*, 1927, **70**, 419; *Amer. Ceram. Abstr.*, 1928, 250), although I. I. Kitiagorodsky and I. A. Schkolnikov (*Sprechsaal*, 1935, **68**, 556) found that an increase in oxygen content from 22 to 90 per cent. did not affect the rate of sulphate formation in the case of sodium carbonate, and suggested that in this case the reaction was a two-stage process:

$$(1)\ Na_2CO_3 + SO_2 = Na_2SO_3 + CO_2$$
$$(2)\ Na_2SO_3 + 1/2O_2 = Na_2SO_4$$

Since the first reaction is relatively slow compared with the second, the presence of excess oxygen was unable to accelerate the reaction as a whole very much.

There is no useful evidence which suggests a critical concentration of sulphur dioxide below

Scumming of Enamels

which perceptible "sulphuring" will not occur, since the factors of time and composition have an important effect. The concentration of sulphur dioxide in normal intermittent kiln firing of bricks and pottery may reach 1 per cent. by volume, but there is evidence that at higher concentrations of sulphur dioxide than this (5 per cent.) the reaction is correspondingly more vigorous (R. F. Geller and A. S. Creamer, *J.* Amer. Ceram. Soc., 1931, **14**, 624).

Oxidizing Atmosphere

There is plenty of experience in the ceramic industry which shows that "sulphuring" can show itself if the kiln atmosphere is made strongly oxidizing at a temperature of 700 deg. C. approx. when the glazed ware is being cooled. There is not then sufficient time (and temperature) for the sulphates, formed on the surface to be fused into the glaze as a whole. If the oxidizing condition occurs during the heating-up of the glaze past this temperature range, then "sulphuring" does not necessarily show itself. It is quite possible, for example, to include sulphates in the glaze in considerable proportions before firing and yet to get a clear glaze under suitable firing conditions. For example, up to 5 per cent. of calcium sulphate or up to 20 per cent. of lead sulphate causes no apparent "sulphuring" effect if the firing conditions are suitable, or is there any evidence that the presence of these sulphates in an unfired glaze causes any greater liability to "sulphuring" in the finished glaze, when the kiln atmosphere contains sulphur dioxide. These facts suggest that "sulphuring" in its deleterious sense is essentially a surface phenomenon, and the important conditions relating to it are those which permit this surface reaction at a time when it is not possible to destroy the film by further fusion or by decomposition.

Since oxidizing conditions promote "sulphuring," it is an obvious suggestion that reducing conditions should lessen it, and the usual technique in the ceramic industry when dealing with glazes is to maintain the kiln atmosphere neutral or very slightly reducing over the critical cooling range from 800 to 400 deg. C. approx. Sulphates are reduced, of course, by carbon monoxide. With calcium sulphate the reduction occurs between 700 and 900 deg. C. (J. Zawadzki *et. al. Roczniki Chem.*, 1925, **5**, 488, 1926, **6**, 120, 236, 1928, **8**, 358). Considerable reduction in the sulphate content of glass has also been found by Jebsen Markwedel and A. Becher (*Glastech. Ber.*, 1930, **8**, 525) by heating in a reducing atmosphere. Suggestions have been frequently made by different workers in the ceramic field to inhibit "sulphuring" by firing in a reducing atmosphere (where practicable) during the cooling range. Water-vapour also appears to promote "sulphuring." H. Hirsch (*British Clayworker*, 1932, 426) showed that the presence of much moisture at 400 deg. C. has a pronounced effect in increasing sulphate formation. F. G. Jackson (*J.* Amer. Ceram. Soc., 1926, **9**, 1954) quotes similar data.

Composition Effect

So far as the effect of composition is concerned, there is much evidence that the presence of calcium derivatives in a glaze (other than sulphates) makes them much more susceptible to "sulphuring" (J. W. Mellor, *Trans.* Ceram. Soc., 1906, **5**, 87, 1906, **6**, 71). In the "sulphuring" of a normal ceramic glaze which contains complex alumino silicates and borosilicates of Na_2O, (K_2O) PbO, CaO (apart from colouring oxides), it has been shown that the amount of sulphate formation after prolonged "sulphuring" is highest for calcium, followed by alkalis (Na_2O and K_2O) and finally lead. This is probably related to the relative thermal stability of the sulphates of these metals.

On the other hand, the rate of attack by SO_2 is greatest if alkalis or free bases are present, *e.g.*, sodium hydroxide and carbonate or similar calcium compounds and felspars. These may arise through the decomposition of borax frits which are a usual constituent of ceramic glazes. When the glaze is finely ground the normally insoluble frit is hydrolized by water to an extent which increases with the reduction in grain size. (This is a common phenomenon with so-called insoluble salts.) The soluble alkaline substances developed tend to form a film on the dried glaze or enamel layer before firing, and, since they react with SO_2 much more rapidly than the borosilicates, etc., they tend to be more sensitive to "sulphuring." The rate of drying has a marked influence on the extent to which these soluble alkaline materials are carried to the surface during the drying operation.

If a mixture of sulphur dioxide and oxygen be passed over a normal (low-solubility) ceramic glaze at 600 deg. C. the rate of absorption of SO_2 (measured by sulphate formation in the glaze) decreases with time, and the figures of SO_2 absorbed and time agree fairly well with a reaction of the second order $k = \frac{1}{ta} \cdot \frac{x}{(a - x)}$ where $x = SO_2$ introduced in t hours, a = total SO_2 when the reaction is complete and k = the reaction constant. Although the fact that the reaction is of the second order is of no particular importance, the equation does enable it to be calculated that 90 per cent. of the reaction is over (at 600 deg. C.) after 16 hours. If, however, a mixture of SO_2 and O_2 is passed over a glaze for 16 hours at different temperatures the resulting curve (Fig. 1) showing the percentage of sulphate (as SO_3) in the glaze at the various temperatures is of some interest.

The curve suggests that the sulphates formed at 500 to 600 deg. C. are not stable at higher temperatures and begin to decompose. At a later stage, more-stable sulphates (or other metals) continue to be formed and increase the total sulphate content of the glaze. The thermal stability of the various sulphates throws some light on this. For example, F. L. Brady and E. H. Coleman (*Trans.* Ceram. Soc., 1931, **30**, 169; 1932, **31**, 58; 1932, **31**, 193) showed that (in the case of brickmaking clays), sulphate

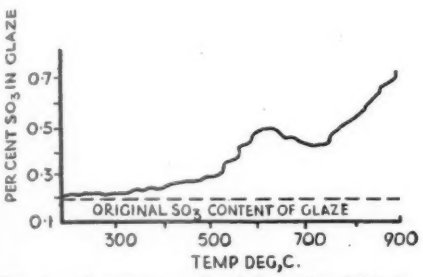

FIG. 1.—*Percentage of sulphate (as SO_3) in a pottery glaze at various temperatures.*

formation reached a maximum of 700 deg. C. and while alkali sulphates could be eliminated by heat-soaking at 900 deg. C. the removal of calcium sulphate needed heat-soaking at 1,110 deg. C. S. S. Cole and S. R. Scholes (*J. Amer. Ceram. Soc.*, 1934, **17**, 135) have published some observations on the temperature of decomposition of some sulphates which may be present in ceramic materials. They quote the observations of K. Friedrick (*Stahl u. Eisen*, 1915, **11**, 1911) and G. Marchal (*J. Chim. Phys.*, 1925, **22**, 493, 559); the latter are probably the more accurate:—

	DECOMPOSITION TEMPS: deg. C.	
SULPHATE		
Beryllium	565	Marchal
Nickel	690	
Cobalt	690	
Manganese	720	
Cadmium	780	
Silver	850	
Magnesium	880	
Iron (ferric)	705	Friedrick
Copper	740	
Zinc	840	
Aluminium	770	

These temperatures will be lower, of course, in the presence of substances such as SiO_2, Al_2O_3, B_2O_3 and china clay.

For example, G. Marchal (*J. Chim. Phys.*, 1926, **23**, 38) gives the following information on calcium sulphate:—

	DECOMPOSITION FIRST OBSERVED. deg. C.
$CaSO_4$	960
$CaSO_4 + SiO_2$	870
$CaSO_4 + Al_2O_3$	950
$CaSO_4$ + china clay	780

SiO_2 also causes a lower-temperature decomposition of sodium sulphate (G. Marchal, *Compt. Rend.*, 1929, **188**, 258), of barium sulphate (1,025 deg. C.) and magnesium sulphate (680 deg.) (G. Marchal, *Bull. Chim.*, 1926, **39**, 401). Other workers have studied the decomposition of sodium sulphate (P. P. Budnikoff and J. K. Syrkin, *Chem. Z.*, 1923, **47**, 22, and K. J. Losevard, S. V. Nikitin, *J.* Chem. Ind. (Moscow), 1929, **6**, 169) who showed that decomposition begins below 800 deg. C. even in the absence of promoting materials such as SiO_2 and B_2O_3. It is thus established that the maximum degree of sulphuring occurs about 700 deg. C. and that the falling off for a time above this temperature is probably due to the thermal decomposition of sodium sulphate (and probably magnesium). In addition, as was said previously, decomposition can also be accelerated by reducing conditions. For example, CO decomposes calcium sulphate between 700 and 900 deg. C. (J. Zawadzki l. c.) while in the presence of fine carbon, magnesium sulphate can be reduced at as low a temperature as 320 deg. C.

Time/Temperature Effect

In all these observations, of course, it must be remembered that the times and temperatures involved are very much greater than those which apply to the fusing of an enamel. Similarly, observations which have been made to show the depth in a glaze layer to which the SO_2 reaction penetrates (by diffusion) are not of direct help, since the time factor in relation to enamel is so disproportionate.

It may be of interest to record that the presence of "sulphuring" conditions when glazes are being fired, and the subsequent decomposition of these sulphates, either by thermal decomposition or reduction, causes a great increase in the bubble development in glazes. SO_2 has been found in the gas contained in some of these bubbles.

Indications for Enamellers

This brief outline of work which has already been carried out in a parallel section of the industry to enamelling suggests:—

(1) The main difficulty is caused by attack of SO_2 and O_2 on the surface, the maximum rate of attack occurring about 700 deg. C. The surface effect persists if there is insufficient time for the sulphates formed to be fused into the mass.

(2) The degree of reaction depends on the concentration of SO_2 and O_2 temperature and time.

(3) The presence of sulphates in the glaze before firing has little or no influence on "sulphuring" in its normal form, but the difference on the time and temperature of firing, between glazes and enamels must be borne in mind in this connection.

(4) A reducing atmosphere tends to inhibit "sulphuring," but increases bubble formation.

(5) Water-vapour accelerates the "sulphuring" process.

(6) The presence of alkalis on the glaze surface before firing may accelerate "sulphuring."

(7) A glaze high in lime (such as complex alumino-silicates, etc.) is particularly liable to "sulphuring."

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APPENDIX

SUMMARY OF RESEARCH ON SULPHUR ATTACK AS EXPERIENCED IN THE GLASS INDUSTRY

TURNER, W. E. S. (*J.* Society of Glass Technology, 1933, **17** 22-24.)

Formation of sodium sulphate in glass furnaces and some defects arising therefrom.

Sulphur dioxide in the products of combustion, together with oxygen, react with basic oxides such as sodium oxide or lead oxide in glasses to form sulphates. With fuels containing relatively high percentages of sulphur and under favourable conditions of temperature quite heavy deposits of sulphate may be formed on glass during reheating processes and even on the surface of molten glass in the working sections of melting furnaces.

COWARD, J. N., and TURNER, W. E.S. (*J.S.G.T.*, 1938, **22**, 309-323.)

Clouding of soda/lime/silica glass in atmospheres containing sulphur dioxide.

Specimens of a glass of percentage composition SiO_2 72.3 R_2O_3 1.2, CaO 9.4, MgO 1.3, Na_2O 15.1, SO_3 0.2, were heated for standard periods of time and at temperatures from 250 to 675 deg. C. separately in atmospheres of sulphur dioxide and of air. In sulphur dioxide, a slight film could be detected after two hours at 250 deg. C., and the weight of deposit increased with temperature. Repetition of the treatment at any one temperature resulted in a less dense and finer deposit, but after the second treatment continued repetition led to films diminishing only slowly in total weight and fineness of grain. The film was completely and readily soluble in water. No sulphite or bi-sulphate was detected; only sodium sulphate. A low concentration (*e.g.*, 1 per cent. by volume) of sulphur dioxide in air was sufficient to yield marked films. The character of the deposit is illustrated by photomicrographs.

BOOW, J., and TURNER, W. E. S. (*J.S.G.T.*, 1938, **22**, 357-371.)

Effect of annealing in a sulphur dioxide containing atmosphere on the modulus of rupture of sheet glass.

Specimens of sheet glass 10 cm. long, 0.85 cm. wide and 0.274 cm. thick, with ground and mechanically-polished edges have been heated at temperatures of 400, 490, 530, 550 and 580 deg. C. for two hours (and, in a number of cases, for additional periods), both in air and in an air/sulphur dioxide mixture.

In both types of atmosphere, heating at temperatures of 490 to 580 deg. C. resulted in an increase in mechanical strength as measured by the modulus of rupture, but the increase by heating in sulphur dioxide-air mixture was considerably greater than in air alone; for example, at 550 deg. C. it was approximately 17 per cent. greater. Light films of sodium sulphate were formed on the glass in two hours at 400 and 490 deg. C., and increased rapidly with temperature between 490 and 580 deg. C. After the first film had been removed, a second treatment in sulphur dioxide/air mixture produced a second film of lighter character, the logarithm of the weight of this second film being inversely proportional to the reciprocal of the absolute temperature of treatment.

DOUGLAS, R. W., and ISARD, J. O. (*J.S.G.T.*, 1949, **33**, 289-335.)

Action of water and of sulphur dioxide on glass surfaces.

The removal of alkali from glass by the reaction with water or sulphur dioxide has been investigated theoretically and experimentally. Both these reactions have been shown to be controlled by diffusion processes within the glass. The type of diffusion process involved is governed by the condition that the electrical neutrality of the glass must be maintained. It is concluded that (*a*) the reaction with water involves the exchange of sodium ions by hydrogen ions and that the reaction is limited by the rate of diffusion of sodium ions to the surface; (*b*) the reaction with sulphur dioxide at 20 to 100 deg. C. in gas saturated with water-vapour involves the same process and proceeds at the same speed as the reaction with water; (*c*) at 100 to 600 deg. C. (and in atmospheres not saturated with water-vapour below 100 deg. C.), the sulphur-dioxide reaction is limited by the rate of diffusion of sodium through a compacted layer of glass at the surface which arises from a secondary dehydration process; (*d*) with anhydrous reagents, the sulphur-dioxide reaction involves the simultaneous diffusion of sodium ions and oxygen ions to the glass surface, and the speed is limited by the rate of diffusion of oxygen ions; above about 700 deg. C. this process predominates over ion exchange.

WILLIAMS, H. S., and WEYL, W. A. (*Glass Ind.*, 1945, **26**, 275-7 and 290-2.)

Surface de-alkalization of finished glassware. Pt. I.

The rôle of the alkali in glasses is chiefly determined by the loose bonds with which the alkali ions are tied up with the silicate network. Its reactivity and its mobility in an electric field can be understood on this basis. In the absence of an electric field, alkali ions can migrate due to forces exerted by surface tension, and if given an opportunity, can react with gases, vapours, fused salts or crystalline substances which are brought in contact with the glass surface.

In this paper, the authors report a novel method for withdrawing alkali from the surface of finished glassware by means of heating the glass in contact with a clay slip or other refractory materials which are capable of reacting with the alkali. Experiments are reported which illustrate the strong effect of this "de-alkalization" by means of metal-kaolin on the chemical reactivity of the glass.

A few new methods are discussed which permit differentiation between unaltered and de-alkalized areas of a glass surface.

The effects of the de-alkalization on the chemical resistivity, electrical conductivity, and strength are discussed.

LONG, B. (*Verres et Refrac*, 1949, **3**, 97.)

Blooming of optical glasses.

The film on the surface of polished glass is principally due to the atmosphere humidity, which, by contact with the glass, promotes the formation of small droplets of an alkaline solution containing a suspension of silica; this solution rapidly carbonates by contact with the carbon dioxide in the air.

The necessity to control the behaviour of polished surfaces of optical glasses to this kind of attack led to the American military authorities, in 1937-38, carrying out, on the one hand, actual experiments on the surface of simple glass compositions for several weeks in the presence of atmospheric constituents, and on the other hand, a "dimming test" carried out indoors in a saturated atmosphere at 80 deg. C. for 30 hours. The results show that the transmission of glasses is more seriously affected by the exposure to damp air than by exposure to the normal outside atmosphere.

TRAVERS, M. W. (*J.S.G.T.*, 1921, **5**, 61-71.)

On the clouding of table-working glass tubing in the blowpipe flame.

The clouding of glass surfaces due to the coal gas flame is most marked under oxidizing conditions.

Hydrogen and carbon dioxide in the products of combustion do not contribute to this clouding, only sulphur trioxide.

The conversion of SO_2 to SO_3 takes place with greater rapidity in contact with certain solids. The SO_2 content of the burned gases in the atmosphere at the edge of the flame in contact with the glass may vary from 2×10^{-4} atmospheres upwards. If at 700 deg. C. in contact with the glass only 0.01 per cent. of the SO_2 were converted to SO_3 the pressure of the SO_3 in the gas would be 2×10^{-6}. It is known that the rate of combination of SO_2 and O_2 in contact with porcelain at 700 deg. C. is of a very low order, and the rate of association in contact with glass is not likely to be of a high order. It therefore appears more than probable that within the limits of the variation in the sulphur content of town's gas there is a certain quantity, which if it is exceeded, will give rise to a pressure of SO_2 in the atmosphere near the edge of the flame, at which the glass will absorb SO_2 to an extent sufficient to cause clouding due to the separation of solid Na_2SO_4 or SiO_2, probably the former.

TAKATS, T. von. (*Glastech Ber*, 1936, **14**, 102-105.)

Reaction of silicates with sulphur dioxide.

Previous work on the reaction of furnace atmosphere with glass has mainly been concerned with reaction during melting. The research which has been carried out by the author shows that the amount of reactivity of SO in the presence of oxygen can be quite considerable at or just below the softening of silicates, resulting in the formation of sulphates on the surfaces in contact with the gases.

With certain silicates it was possible to determine the extent of the reactions by analytical means. It is possible to examine by this method the sensitivity of glass compositions to "blooming," due to the presence of sulphur in furnace gases.

GUSS, S. (*Glashutte*, 1930, **60**, 935 and 954; 1931, **61**, 8.)

Some refections on "Lehr Bloom."

Glass only tends to become lehr bloomed when annealed in furnaces fired by gases yielding products of combustion containing sulphur oxides.

Lehr bloom does not take place when annealing is carried out in furnaces heated electrically or by purified gas.

Bloom formation is greatest during the initial annealing, and if the process is repeated the attack becomes progressively less until a stage is reached when it is very difficult to obtain any further film. The reduction in the amount of bloom obtained in subsequent treatments is due to the gradual removal of alkali from the glass at the surface.

At low temperatures (below 350 deg. C.) no blooming takes place even in the presence of sulphur gases.

HOSTETTER, J. C. (*Bull.* Amer. Ceram. Soc., 1923, **2**, 295.)

"Sulphuring" of Glasses.

Sulphuring may be the result of several causes, one predominating at one time and another at another time under some conditions. It sometimes occurs during working of glass, and sometimes in the lehrs.

Surface attack can be obtained by materials such as paper, cork and glue when moisture is present. It was thought that the organic acids so brought into solution may be stronger than the silicic acids and thus account for the reaction.

CRESPI, M., and MILES, E. (*Anales* de la Soc. Espanola de Fisica y Quimica, 1926, **24**, 452.)

Absorption of gases on glass walls. III: Sulphur dioxide.

(No details available.)

Reduction of Moulding Costs

By W. Gudgeon

When a number of castings is required from the same pattern, it often happens that after a few have been cast certain alterations suggest themselves, which, if carried out would simplify moulding operations and result in a saving of time on the job. The sketches shown are of a casting where two changes in moulding methods were made after a number of castings had been produced. Fig. 1 shows the casting as it is moulded in the floor and, Fig. 2, when it is turned over. The pattern is made in two parts, the round top, measuring 2 ft. 9 in. dia., with a depth of 3 in., and the other part 1 ft. 6 in. long. Twenty-six core prints ⅜ in. dia. are located on the outside of the rim. The overall thickness of metal is ⅜ in., casting weighing 8 cwt.

The shape of the core (Fig. 3) more often than not made its lowering in the mould an awkward and uncertain operation. This was because the overhanging part of the core obscured the print at the bottom of the mould. To overcome this difficulty, the core was next made in two parts, the rectangular portion being lowered first and the other half of the core joining it as it settled in the print. A ⅜-in. stud is fixed between it and the wall of the mould to keep it from falling over, a piece of slab core being rammed up in the mould to provide a firm seat for the stud.

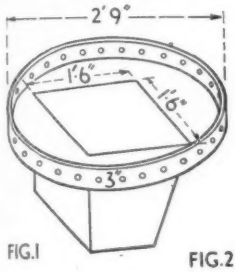


FIG.1

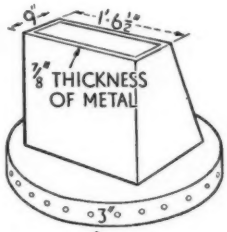
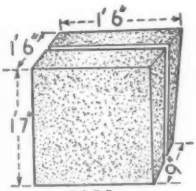


FIG.2



CORE
FIG.3

FIGS. 1 TO 3.—*Casting for which the method was modified to give more economical production; Fig.* 1 *as moulded; Fig.* 2 *as turned over; and Fig.* 3 *the core divided to simplify its location.*

A second alteration had to do with the top part of the pattern. Previously, a 3-in. depth of sand was rammed up in the top part, with a supply of gaggers hooked on to the box bars. This method was changed by making an oil-sand core from out of the circular pattern and, when dry, setting it centrally in the mould, where it rested on the core below. The ⅜-in. dia. cores in the periphery were then fixed in their prints so that they were touching the large circular core thus making sure of a clean hole, to allow clearance for the top part when closing the mould. As numbers of this casting were ordered periodically, it will be seen that it paid to make these alterations, as thereby much time was saved. In the end, a flat top part was all that was necessary to close the mould, no more complaints coming from the dressing shop of "blind" holes.

Book Reviews

Principles of Mass and Flow Production, by Frank G. Woollard, M.B.E., M.I.Mech.E. Published by Iliffe & Sons, Limited, Dorset House, Stamford Street, London, S.E.1. Price 25s.

The Author is well known in foundry circles and one might have expected that he would include more reference to the making of castings than he has. However, the general substance of the book does give ample material of real interest to the foundryman. Mr. Woollard writes well—much better than most authors of technical books—and his last chapter on Human Relations is far more acceptable than most of the platitudes printed under this heading. He deals with this subject from a commendably broad aspect. Throughout the book, there are thought-provoking statements and quotations. A new one to the reviewer is that all America is working overtime to make labour-saving machines. Because the book makes most interesting reading to the layman, it must for the mechanical engineer be of the most satisfying character. The Author draws much upon the automobile manufacturing industry and what better could there be for quantity production? The book is very reasonably priced and can be unreservedly commended to those whose interests lie in this field.

V. C. F.

Mechanical Testing of Metallic Materials (3rd Edition) by R. A. Beaumont. Published by Sir Isaac Pitman and Sons, Limited, Parker Street, Kingsway, London, W.C.2. Price 25s. net.

This technical manual is based on the lecture course given by the author at the College of Aeronautical Engineering, Chelsea, and is an excellent book for technical students and inspectors. Attention is centred mainly on the tensile test, "with special reference to proof stress" determinations as indicated in the subtitle. Both the text and the illustrations of machines, extensometers and test-pieces provide a thorough and clear account of this part of mechanical testing. The new "four-point method" for proof stress devised by Lindley and Crow for materials whose characteristics are well known is described in detail, as well as the rapid calculator or "indicator" devised by the author. No mention appears to be made of the upper and lower yield point in mild steel. A chapter is included on radiology and methods of crack detection.

In such a wide field, some selection has naturally had to be made, and whilst creep tests and tensile tests at elevated temperatures are dealt with, the same does not apply to impact or hardness tests. No dynamic hardness machines are included, and cupping tests like the Erichsen have been omitted. The problem of dealing with large specimens, such as rolls, is not considered but care has been taken over the proof testing of small specimens, especially those extracted from steel and light-alloy castings. This information comes on pages 109-114 but the index does not tell us so. The Hounsfield Tensometer only gets three lines, and is not included in the index.

The ironfounder will probably be curious to know what is said about the popular transverse beam test. The index gives pp. 18 and 24 for transverse tests, but the reference here is simply to the effect of the direction of the fibre in wrought metal. He must be content with a mention on pp. 41 and 43 that transverse tests may be carried out on the Avery-Buckton machine.

The present publication is the third edition, thus demonstrating appreciation shown for a work by a skilled and experienced author. H. O'N.

British and World Shipbuilding

Lloyd's Return for June Quarter

Lloyd's Register of shipbuilding returns relating to merchant ships of 100 tons gross and upwards, for the quarter ended June, shows that in Great Britain and Northern Ireland at that date, steamships and motorships under construction totalled 328 ships of 2,195,085 gross tons, compared with 323 ships of 2,175,760 tons in the previous quarter. The total includes 129 steamers of 1,247,406 tons and 199 motorships of 947,679 tons. In the remainder of the Commonwealth 39 ships of 135,136 tons were under construction compared with 44 ships of 134,856 tons in the March quarter, these vessels including 22 steamers of 71,446 tons and 20 motorships of 76,050 tons. Oil tankers of 1,000 tons and upwards building in Great Britain and Northern Ireland totalled 89 ships of 1,135,693 tons compared with 92 ships of 1,116,998 tons in the March quarter and representing 51.7 per cent. of the total tonnage under construction in this country. World figures of ships being built totalled 324 steamers of 2,966,806 tons and 761 motorships of 2,880,968 tons, making a total of 1,092 ships of 5,848,891 tons (including a few small wooden vessels), compared with 1,137 ships of 6,167,002 tons in the previous quarter. Ships under construction in the principal districts of Great Britain and Northern Ireland are shown in Table I.

TABLE I.—*Ships Under Construction in Principal Districts of Great Britain and Northern Ireland.*

District.	June 30, 1954.		March 31, 1954.		June 30, 1953.	
	No.	Gross tonnage.	No.	Gross tonnage.	No.	Gross tonnage.
Aberdeen ..	20	25,652	17	27,182	14	26,761
Barrow ..	6	116,120	5	85,120	4	85,340
Belfast	17	222,880	16	204,760	16	188,400
Bristol	5	3,640	7	4,620	4	2,050
Clyde—						
Glasgow ..	84	549,571	87	564,841	79	534,107
Greenock ..	31	197,320	34	228,297	31	204,860
Dundee ..	6	37,850	6	43,150	7	49,010
Hartlepool ..	8	51,074	9	55,519	9	51,750
Hull	27	13,633	22	11,785	25	15,032
Leith	10	38,420	13	36,000	11	37,420
Liverpool ..	14	134,313	16	148,201	16	141,441
Middlesbrough ..	17	218,460	15	204,044	16	189,030
Newcastle-upon-Tyne ..	40	382,809	35	332,148	42	390,555
Southampton ..	4	6,154	5	6,574	9	7,764
Sunderland ..	26	191,095	30	220,980	28	198,120

The sizes of steamships and motorships under construction in Great Britain and Northern Ireland in the June quarter were as follow:—100 to 1,000 tons, 26 steam (68 motor); 1,000 to 2,000 tons, 4 steam (21); 2,000 to 4,000 tons, 12 steam (11); 4,000 to 6,000 tons, 5 steam (19); 6,000 to 8,000 tons, 12 steam (29); 8,000 to 10,000 tons, 15 steam (15); 10,000 to 15,000 tons, 21 steam (33); 15,000 to 20,000 tons, 12 steam (3); 20,000 to 25,000 tons, 20 steam (nil); 25,000 to 30,000 tons, 1 steam (nil); 30,000 tons and over, 1 steam (nil).

Steamships and motorships under construction abroad, excluding China, Poland, and Russia, at the end of June totalled 764 ships of 3,653,806 tons gross, a decrease of 337,436 tons as compared with the figures for the March quarter. Oil tankers under construction total 195 ships of 2,217,829 tons, which is 107,814 tons less than in the March quarter, and represents 60.7 per cent. of the total tonnage being built abroad. They include 29 of 355,257 tons under construction in Germany; 26 of 311,719 tons in Sweden; 19 of 294,700 tons in France; 24 of 287,761 tons in the Netherlands; and 16 of 272,962 tons in the United States of America.

The ships being built in the world at the end of June include 22 steamships and 65 motorships of between 6,000 and 8,000 tons each; 26 steamships and 37 motorships of between 8,000 and 10,000 tons; 61 steamships and 81 motorships of between 10,000 and 15,000 tons; 36 steamships and 15 motorships of between 15,000 and 20,000 tons; 44 steamships and three motorships of between 20,000 and 30,000 tons each; and one steamship of an estimated 31,000 tons. The tonnage being constructed abroad comprised 1,719,400 tons of steamships and 1,934,406 tons of motorships. Oil tankers under construction in the world amount to 284 ships of 3,353,522 tons (128 steamships of 2,008,764 tons and 156 motorships of 1,344,758 tons), which is 89,119 tons less than the comparable figure for March. In the same period, the oil tanker percentage of the total tonnage under construction in the world has increased from 55.8 to 57.3 per cent.

Parliamentary

UK Participation in Trade Fairs

In the House of Lords on July 20, LORD BALFOUR of INCHRYE asked the Government whether, in the interest of inter-Commonwealth trade, reconsideration could be given to the policy of restricting U.K. participation in trade exhibitions and fairs to those held in dollar countries.

LORD MANCROFT, Lord-in-Waiting, who replied, said that the main U.K. participation in trade exhibitions and fairs took the form of exhibits by individual exporters and their agents. The Government took part in a limited number of trade fairs only, most of which were not in dollar countries.

THE COST, exclusive of fees and equipment, of the new buildings for technological studies which are being started in 1953 and 1954 is estimated at approximately £2,700,000, most of which will be met by grant. Further extensions to this programme are under consideration. (Chancellor of the Exchequer.)

THE House of Commons adjourned for the summer recess last Friday. The Lord Privy Seal announced previously that the proposed date of meeting after the recess would be October 19.

THE TRADING LOSS of the Ministry of Materials up to March 31 last was approximately £55,000,000. The Minister of State, Board of Trade, also said that there might well be some further loss resulting from the terminal clearing up.

Personal

THE REFINED IRON COMPANY (DARWEN), LIMITED, announce that Mr. J. Barnes, M.I.B.F., has joined their sales staff.

Mr. A. A. BRUNEAU has been appointed an assistant secretary of Aluminium, Limited, in succession to Mr. J. A. PATERSON, who has resigned.

Mr. N. J. SHERGOLD has been appointed manager of a new branch office of Air Control Installations, Limited, Ruislip (Middx), to be opened in the Newcastle-upon-Tyne district.

MR. R. G. BRAITHWAITE, M.I.C.E., director and welding consultant to Braithwaite & Company (Structural) Limited, was installed as president of the Institute of Welding at the annual general meeting on July 20 in succession to Mr. A. Robert Jenkins, J.P., M.I.Mech.E.

Obituary

Mr. CHARLES PARKER, a former director and works manager of the Raleigh Cycle Company, Limited, has died at the age of 68. He was also a director of Sturmey-Archer Gears, Limited.

Mr. FRANK MARSDEN, who has died at the age of 82, was formerly a partner in the ironfounding firm of Marsden & Naylor, Limited, which is now carried on by David King & Sons, Limited, of Skipton (Yorks).

THE DEATH has occurred of MR. JOHN FIELD TONGUE who joined the Birmingham firm of Belliss & Morcom, Limited, 50 years ago. He was 78. Mr. Tongue became the company's leading installations engineer on overseas contracts.

COLONEL R. W. J. PRYER, principal of the School of Electronics, Malvern, since September, 1948, has died at his home in Malvern at the age of 57. Col. Pryer, a graduate in engineering of London University, has been responsible for building up and equipping the school from its inception.

THE DEATH is announced of DR. H. A. SCHWARTZ, a metallurgist of international repute and a leading authority on malleable cast iron. Only recently he retired from the position of manager of research with the National Malleable and Steel Castings Company, of Cleveland, Ohio. He was 74 years old. He has been very prominent in the affairs of the American Foundrymen's Society, which he joined in 1909. In 1939, he was the recipient of the E. J. Fox Gold Medal at the London International, and because of the political crisis he and his wife were the sole Americans present. The honour which Dr. Schwartz received was outstanding because he has been the only overseas recipient. In receiving the award, he modestly accepted it as recognition of the team of scientists he headed. He was the author of numerous papers, and they make an indelible mark on the literature of foundry metallurgy.

ALLIED IRONFOUNDERS, LIMITED—Mr. Guy Savile Steven has been appointed deputy managing director.

WELLMAN SMITH OWEN ENGINEERING CORPORATION, LIMITED—Mr. Colin John Barker has been appointed general managing director. Mr. Frederick Harold Brooks has been appointed managing director in charge of production and technical development. Mr. Barker was formerly joint managing director and Mr. Brooks was formerly technical director.

Grinding Research Project

Professor G. Pahlitzsch, professor of Machine Tools and Plant Organization and Dean of the Faculty of Machinery and Electrotechnics at Brunswick University, returned to Germany on July 3 after a week spent at Birmingham University. As a result of his visit, the Department of Engineering Production at Birmingham, under the direction of Professor T. U. Mathew, is shortly to begin its research project on surface finishing and grinding (previously announced) by experimenting with a new method of lubricating and cooling ceramic grinding wheels which he has pioneered. A research Fellow is to be appointed and it is hoped that he will visit Prof. Pahlitzsch's laboratories in Germany.

At a meeting in Birmingham jointly organized by the Midland Section of the Institution of Production Engineers and the University, and attended by some 150 engineers from all parts of the country, Prof. Pahlitzsch demonstrated and explained his method. It consists of feeding drops of oil into the core of the grinding wheel and, as the wheel revolves at high speed, by centrifugal action the oil finds its way to the surface at the point where the item is being ground. From the outside of the wheel, water is sprayed to cool the item. The method, it is claimed, obviates the need for frequent trueing with diamonds, a technique now essential to ensure that the wheel maintains a uniform standard of roughness. A saving of 22 per cent. trueing time is quoted for the new method, and 22 per cent. in diamond costs. As the wheel also runs faster, labour and machine costs together and cut by as much as 35 per cent., while 25 per cent. is saved in grinding-wheel costs. The method was originally devised for cylindrical grinding, but is thought to be applicable to surface grinding and possibly to centreless grinding. As the production of precision parts with a high degree of surfaee finish is increasingly required in engineering products, the research at Birmingham will have much general interest.

British Standards Institution Export Panel

The British Standards Institution announces the formation of a small Export Panel consisting of leading industrialists who are actively engaged in the markets of the world. The Panel will advise the Institution on how best it can assist export trade. The volume and range of overseas work connected with standards has increased greatly in recent years, and has become a factor of growing importance to our exporting industries. The development of national standards in overseas countries has a direct bearing on British manufacturers' export activities, and therefore demands that British industry should, through the B.S.I., take a leading part in influencing developments in the international standards field. Fundamentally, the Institution's job in this sphere is to limit the necessity for British manufacturers to produce a variety of goods to comply with a variety of different standards in different countries. To enable manufacturers to take account of other countries' standards in their production for export, B.S.I. provides British industry with a complete service of information about overseas standards; and it is equally necessary that in formulating British Standards full account should be taken of the requirements of export markets as expressed in their own standards.

News in Brief

MEMBERS of the Manchester Association of Engineers are to visit the works of Magnesium Elektron, Limited, at Clifton Junction, on August 11.

PRESSURE die-cast aluminium parts weighing up to 75 lb. are now being made possible in the States through the use of a 250-ton die-casting machine.

HER MAJESTY THE QUEEN is expected to visit works of the English Steel Corporation, Sheffield, on her occasion of a two-day visit to the West Riding of Yorkshire in October.

ROOTES GROUP of service plants in Manchester and London are to carry out a $1,800,000 (about £643,000) contract from the United States army for the reconditioning of 4,500 vehicles.

ENGLISH STEEL CORPORATION, LIMITED, Sheffield, are to have a stand at the special British Trade Fair in Baghdad next October. They will show oil-well drilling tools and other products used in the area.

R. W. CRABTREE & SONS, engineers and printing machinery manufacturers, Leeds, have acquired the £135,000 share capital of the Bren Manufacturing Company, Limited, Team Valley Trading Estate, Gateshead.

THE average selling prices (to the nearest 10s.) of members of the Federation of Light Metal Smelters for the following alloys during the month of June were:—LM1, £143 per ton; LM2, £153 10s.; LM4, £160 10s.; LM6, £182.

THE ENGLISH STEEL CORPORATION, LIMITED, River Don Works, Sheffield, has celebrated the 25th anniversary of its formation. It was formed from Vickers-Armstrongs, Limited, and Cammell Laird & Company, Limited, which have a much older history.

FOLLOWING DEMONSTRATIONS of Polygram Shell Moulding Equipment in Sydney and Melbourne, Australia, by Mr. J. Fallows, technical director, Polygram Casting Company, Limited, of Chiswick, have received substantial orders for various types of machines.

WHEN David Brown Tractors, Limited, Meltham, near Huddersfield, closed down last week for a fortnight's holiday, £31,470 was paid to members of the firm's holiday club, an increase on previous years. Over £109,936, including holiday savings, was paid out in wages.

THE BRASS AND IRON FOUNDRY of Irvine & Dyer, Limited, at Hebburn (Co. Durham), which was closed some months ago, has been offered for sale by auction. No offers were received for the works as a going concern, or for the buildings. Plant and equipment were sold by lots.

WILLIAM RIGLEY AND SONS, LIMITED, are building a new 16,000 sq. ft. factory at Bulwell, Nottingham, to make pithead equipment to modernize Britain's collieries. At this factory any heavy construction work will be undertaken, but their specialization is pithead gear and coal-preparation plant.

BY APPROVAL of the Board of Trade, Cementation (Muffelite), Limited, of London, has been licensed to manufacture the products of the Barry Corporation, of Watertown, Massachusetts, U.S.A., for sale in Great Britain and on the Continent. These relate to shock and vibration isolation equipment.

EDGAR ALLEN & COMPANY, LIMITED, Sheffield, have just despatched a combination tube-mill weighing 48 tons which is to be used in grinding raw materials in a chemical factory. This type of mill is one of the specialities of the firm. It is 50 ft. in length by 10 ft. dia.

JOHN BROWN AND COMPANY, LIMITED, shipbuilders and general engineers, Sheffield and Clydebank, have acquired from A. C. Wickman (Canada) the assets and business of the manufacture of tungsten carbide equipment, and the business as agent and factor of machine tools. John Brown already have considerable interests in Canada, including Firth Brown Steels and Firth Brown Tools (Canada).

BECAUSE of their confidence in the increasing demand for synthetic resins for the shell-moulding process, Blackburn and Oliver, Limited, Lamberhead Industrial Estate, Pemberton, Wigan, are installing a large new plant which will be in production next month. This will enable them to increase their annual production by 1,500 tons, much of which will be especially suited for the shell-moulding process.

THE FIRST European conference devoted entirely to management problems is being held in Great Britain from October 20-23. It is being organized by the British Institute of Management at the special request of the European Council of the International Committee for Scientific Management (C.I.O.S.). It will be attended by distinguished representatives from fourteen European countries and will take place at Torquay.

A 2,000-YEAR-OLD EARTHEN FORT, Nadbury Camp, probably built as a defence against the Romans, which dominates the south Warwickshire plain, may be dug up as part of an open-cast ironstone mining project. This was stated at a public inquiry at Banbury, when the Sheepbridge Company, Limited, and the Banbury Ironstone Company, Limited, applied for permission to work 735 acres of south Warwickshire countryside over the next 25 years.

MONSANTO CHEMICALS, LIMITED, announce that Mr. N. F. Patterson was appointed a director of the company. Mr. Patterson, who joined Monsanto in 1946, became works manager at Ruabon in 1947, and in July, 1949, was appointed general manager of production, with responsibility for all the production operations of the company. He is a director also of Monsanto (Soil Conditioners), Limited, and Monsanto Plastics, Limited, subsidiary companies of Monsanto Chemicals, Limited.

THE BIRMINGHAM AND DISTRICT INDUSTRIAL SAFETY GROUP is planning a novel centrepiece for its third biennial Safety and Factory Efficiency Exhibition in Bingley Hall, Birmingham, next June—an "ideal factory," producing goods and laid out to show the best and safest working practice. Local firms are lending plant to equip the factory, which will include the latest types of mechanical handling devices. During the exhibition, from June 24 to July 1, the model demonstration factory will daily receive supplies of raw materials and send out quantities of finished goods.

DURING the annual holidays of the firm, the Smethwick engineering company of Evered and Company, Limited, are moving an entire department into new premises. The transfer will be completed by August 9. It is hoped that the move into a modern factory fully equipped for the manufacture of brass electric, gas and water fittings, will increase production by 50 per cent. The new department will start work with 230 operators although there is room for expansion to a full complement of 450. The move is the biggest single extension of the firm since it was started in Smethwick in 1866 with a 3-storey block previously used for making wire frames for crinolines.

Influence of Atmospheric Moisture on Cupola Metal

In an article by Mr. J. L. Brooks, published in the July 1 issue of *Iron Age*, it is stated that with increased moisture content in the air blast for operating a cupola, total carbon and silicon contents decrease and combined carbon increases considerably. The chill depth also increases from 0.75 in. to 1.5 in. The temperature of the metal is lowered from 1,415 deg. C. to 1,360 deg. C. as a result of the increased moisture content. The melting rate is also adversely affected.

After trying refrigeration and other means of dehumidifying, his company (Muskegon Piston Ring Company) used a system of passing the air through solid absorbents as their method of removing moisture. The system automatically switches the flow of air from one bed of solid absorbent material to another on a definite schedule. While one bed was removing moisture from the air, another bed was being reconditioned by heating. The equipment was installed in conjunction with the hot-blast system and was superior to the old refrigeration system, resulting in closer control and lower operating costs.

Kathabar absorption-type dehumidifiers manufactured by the Surface Combustion Corp., Toledo, were installed recently to maintain the moisture content of the blast at a constant 3 gr. per cub. ft. This system employs a lithium-chloride base solution as an air washer to remove the moisture from the blast air to any desired level. It is automatic in its operation. Regeneration of the absorbent solution is also continuous and automatic. This system has proved to be a very practical method of securing moisture control from a cost and performance viewpoint.

E.C.S.C. Iron and Steel Production

Production of iron and steel in the countries within the European Coal and Steel Community during the first half of 1954 is shown in the following table.

	Pig-iron.	Crude steel.
	Metric tons.	Metric tons.
W. Germany	5,545,000	7,864,000
Belgium	2,196,000	2,350,000
France	4,125,000	5,026,000
Saar	1,120,000	1,263,000
Italy	636,000	1,970,000
Luxemburg	1,309,000	1,297,000
Netherlands	296,000	447,000
Total E.C.S.C.	15,227,000	20,217,000

Internal Combustion Engine Research

At a recent annual general meeting of the British Internal Combustion Engine Research Association, the Rt. Hon. the Viscount Falmouth, M.I.Mech.E., was re-elected president. Sir Harold Cox, Ph.D., D.I.C., F.R.S.; Dr. S. F. Dorey, C.B.E, M.I.Mech.E., F.R.S., chief engineer surveyor, Lloyd's Register of Shipping; Major-General H. R. B. Foote, V.C., C.B., D.S.O., director-general, Fighting Vehicles Division, Ministry of Supply; and vice-admiral (E) F. T. Mason, C.B., engineer-in-chief of the Fleet, were re-elected vice-presidents. Mr. G. W. Bone, Mr. J. Calderwood, Dr. A. R. Morcom and Mr. A. V. Wilkin were elected to the Council; the Council also includes Mr. H. D. Carter, Mr. C. G. Tangye, and Mr. G. A. McMillan (representing the Department of Scientific and Industrial Research).

New Catalogues

Basic Bricks. A leaflet received from the Oughtibridge Silica Firebrick Company, Limited Streetley Brick Works, near Worksop, Notts, details the properties of "Serfex A" basic bricks for use in open-hearth furnaces.

Oil Burners. A four-page leaflet received from the Kingdom Engineering Company Limited, 22, Waterloo Road, Wolverhampton, describes and illustrates by means of a line drawing a range of five sizes of oil burners, known as "proportioning" burners. A clear technical description is given of the apparatus. It is available to our readers on writing to Wolverhampton.

Shotblasting to the Trade. Maps are always good publicity, but the firm of R. J. Richardson & Sons Limited, Commercial Street, Birmingham, 1, have gone a step further. On opening out a folder, detailing the services they give, there stands up a three-dimensional model of the works, properly positioned in the surrounding map of Birmingham streets. This will be available to readers in the near future. The firm is completing the installation of a Tilghman shot-blast room capable of dealing with castings weighing up to 10 tons and to a maximum of 30 ft. long and 10 ft. high or wide.

Thermo-electric Pyrometers. Book 112, received from the Foster Instrument Company, Limited, Letchworth, Herts, approaches the reviewer's ideal as to what a catalogue covering the subject of pyrometers should be, because it first illustrates the development of the circuit before elaborating the apparatus. There is quite a good section devoted to foundry application, with distinct differences between non-ferrous, iron and steel. This 100-page catalogue is well-produced, essentially practical, and nicely illustrated, but devoid of extravagance in presentation. It is available to readers on writing to Letchworth.

Di-electric Heating. A most interesting brochure on di-electric heating from Metropolitan-Vickers Electrical Company, Limited, Trafford Park, Manchester, carries a general introduction to the subject so well written that a highly technical subject has been made so simple that it can easily be assimilated by the lay mind. The basic principles having been set out, the equipment is explained by a line drawing, thereafter applications to various drying processes are detailed. Towards the end of the brochure, core drying is covered. Here, it is stated, together with much useful information, that resin binders are to be preferred when di-electric stoves are in use. The brochure is available to readers on application to the publicity department of the company.

Non-ferrous Castings. A 22-page, nicely-illustrated brochure has been received from the Sandwell Casting Company of Bank Street Foundry, West Bromwich. In general, very good balance has been achieved for each page, but not quite such a pleasing effect is given for two facing pages—a feature which should have been noticed when the brochure was in dummy form. The sequence of the pictures is orderly and the use of a typical casting or other small picture as an inset is commendable. Whilst the illustrations show that good attention has been paid to handling, there is, as the reviewer has noticed only too frequently in foundries, a tendency to use floor space instead of stillages for temporary storage pending transport or further processing. The colour scheme chosen is quite pleasing, and as an example of modern business publications this catalogue ranks high.

Imports and Exports of Iron and Steel in June

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in June. For the purpose of comparison, totals for the first six months of this year and last are also included. (All figures in tons.)

Total Exports of Iron and Steel

Destination.	Month ended June 30.	Six months ended June 30.	
	1954.	1953.	1954.
Channel Islands	256	1,690	2,077
Cyprus	831	5,137	3,856
Sierra Leone	728	3,400	6,184
Gold Coast	3,368	16,867	18,959
Nigeria	6,277	20,049	28,932
Union of South Africa	3,328	63,586	19,969
Northern Rhodesia	234	9,971	2,407
Southern Rhodesia	4,286	27,296	25,323
Tanganyika	3,420	6,761	9,279
Kenya	6,258	32,047	36,051
Uganda	186	4,309	3,199
Mauritius	249	3,572	3,446
Bahrein, Qater, and Trucial Oman	2,086	12,295	12,945
Kuwait	141	7,428	3,609
India	6,894	24,808	44,458
Pakistan	2,346	13,749	21,990
Singapore	1,286	12,273	13,870
Malaya	1,797	13,266	12,289
Ceylon	1,271	8,358	9,413
British North Borneo	379	2,044	2,031
Hongkong	1,940	14,471	9,556
Australia	28,355	66,940	120,671
New Zealand	17,534	56,666	92,701
Canada	18,071	93,020	96,319
Jamaica	876	5,572	6,929
Trinidad	2,429	17,268	19,456
British Guiana	419	2,453	2,554
Anglo-Egyptian Sudan	4,343	12,256	18,178
Other Commonwealth countries	2,250	26,795	14,559
Eire	3,427	18,160	23,757
Soviet Union	—	2	—
Finland	7,637	14,390	33,412
Sweden	5,550	37,604	37,685
Norway	5,955	31,677	38,748
Denmark	5,202	46,401	44,944
Western Germany	947	4,641	3,275
Netherlands	8,106	62,012	48,807
Belgium	817	8,439	5,465
France	497	5,760	2,736
Switzerland	822	5,118	5,392
Portugal	698	9,279	5,391
Spain	1,528	1,816	3,284
Italy	2,733	22,922	24,720
Austria	251	662	727
Yugoslavia	6,273	1,840	8,596
Turkey	1,190	6,087	6,393
Netherlands Antilles	94	5,230	2,015
Portuguese E. Africa	178	1,529	1,355
Lebanon	255	2,666	1,018
Israel	1,022	3,063	5,222
Egypt	827	12,674	16,325
Saudi Arabia	85	748	1,250
Iraq	2,504	28,848	17,673
Iran	772	1,789	3,331
Burma	695	4,396	5,327
Thailand	709	4,855	3,798
Indonesia	271	6,890	3,388
Philippine Republic	387	1,159	2,085
U.S.A.	3,235	36,592	14,019
Colombia	1,548	5,084	4,060
Venezuela	3,964	25,623	20,393
Ecuador	347	1,505	1,659
Peru	342	5,042	3,154
Chile	61	961	754
Brazil	68	1,484	354
Uruguay	824	763	8,623
Argentina	4,044	7,506	33,709
Other foreign countries	4,519	18,194	40,177
TOTAL	200,222	1,037,758	1,144,231

BELLISS & MORCOM, LIMITED—Mr. E. Ll. Morcom, vice-chairman, has relinquished his seat on the board. Mr. Alfred Morcom has been appointed an additional director.

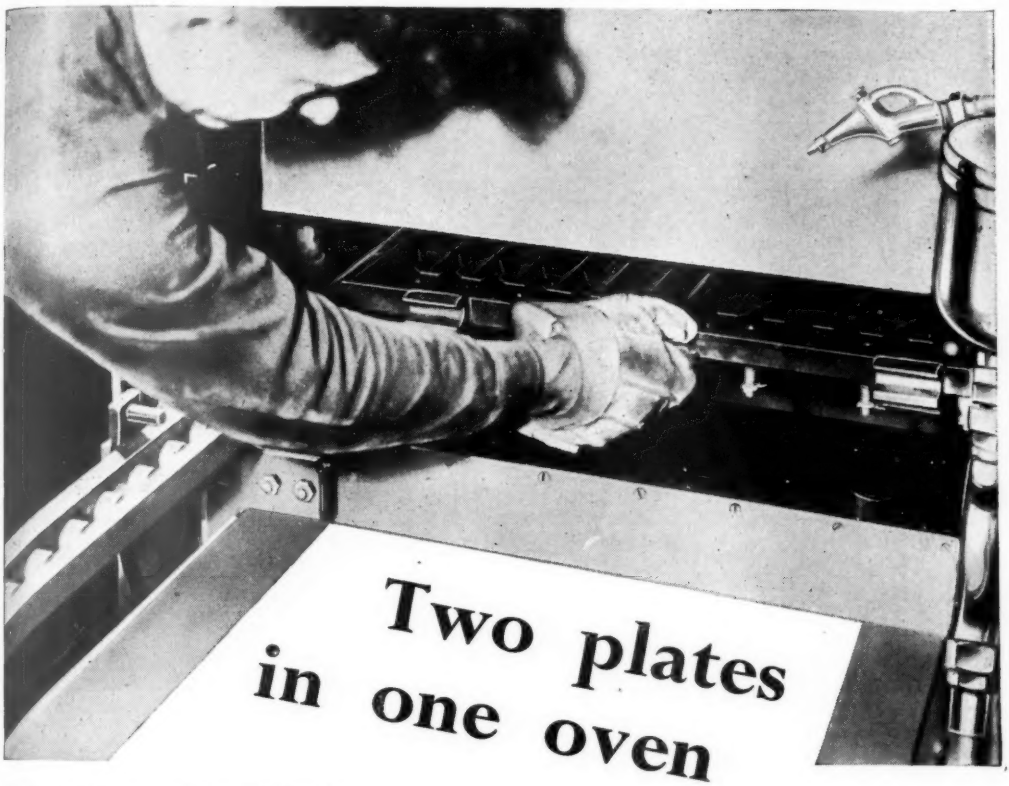
Total Imports of Iron and Steel

From	Month ended June 30.	Six months ended June 30.	
	1954.	1953.	1954.
Canada	1,969	58,566	5,050
Other Commonwealth countries and Eire	768	60,499	13,100
Sweden	8,591	8,982	21,543
Norway	3,325	30,738	14,820
Western Germany	157	24,773	39,818
Netherlands	9,573	67,224	52,976
Belgium	3,225	131,070	23,374
Luxembourg	1,215	68,315	10,016
France	8,858	154,185	40,075
Italy	3,704	12,740	6,394
Austria	18,372	227,788	116,705
Japan	—	56,210	35
U.S.A.	860	97,351	38,525
Other foreign countries	8,235	29,651	93,590
TOTAL	68,852	1,028,092	476,021
Iron and steel scrap and waste, fit only for the recovery of metal	63,194	420,828	405,274

Exports of Iron and Steel by Product

Product.	Month ended June 30.	Six months ended June 30.	
	1954.	1953.	1954.
Pig-iron	4,571	2,974	10,413
Ferro-tungsten	35	28	313
Other ferro-alloys	267	1,254	4,907
Ingots, blooms, billets, slabs, sheet and tinplate bars	62	313	1,320
Iron bars, rods, and sections	210	1,168	1,327
Steel bars, rods, sections, and shapes	32,855	140,193	156,220
Iron plates and sheets	6	215	295
Universal plates	207	6,021	2,754
Steel plates, ⅛ in. and under ¼ in.	1,096	4,222	6,296
Do., ¼ in. and over	17,365	109,561	77,659
Black sheets and black plate	16,700	89,548	100,612
Hoop and strip	7,711	30,765	51,678
Tinplate	24,679	131,307	151,943
Tinned sheets, terneplate, and terne sheets	150	860	1,161
Decorated tinplate	258	753	1,336
Galvanized sheets	16,355	50,676	82,167
Other coated plates and sheets	545	5,134	4,067
Railway and tramway construction material	21,746	126,443	123,253
Wire rods	2,541	7,078	16,067
Wire	8,222	22,389	41,817
Tubes, pipes, and fittings	43,781	299,020	298,880
Iron castings	160	3,279	5,790
Steel castings	218	1,560	1,749
Forgings	482	2,997	2,207
TOTAL	200,222	1,037,758	1,144,231

CARBODIES, LIMITED—Sir Bernard Docker, chairman of Birmingham Small Arms Company, Limited, which recently announced the purchase of Carbodies, Limited, has become chairman of the company on the completion of purchase. Mr. R. Jones has resigned as governing director and his son, Mr. Ernest Jones, as managing director. The new managing director is Mr. R. E. Smith, who will continue as a director and general manager of the Daimler Company, Limited.



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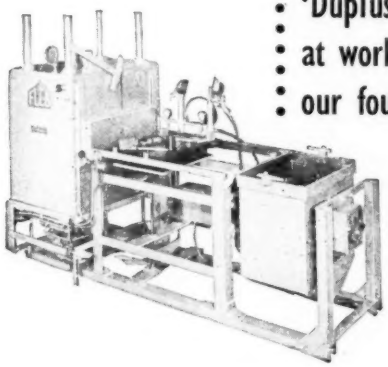

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Raw Material Markets

Iron and Steel

Holidays are reducing both production and demand for castings and at the moment business generally is quiet. The engineering and speciality foundries have good order-books, but this favourable position is not shared by many of the light, jobbing, and textile foundries, which find it difficult to secure enough orders to keep plant occupied. Some producers of light castings have a fair amount of work on hand, but business is on a fluctuating scale and forward buying is negligible. The light foundries producing castings for domestic equipment are short of work; they have to depend mainly on orders from home sources and have not yet been able to expand their export business.

The engineering foundries still complain of inadequate supplies of low- and medium-phosphorus irons, but demand for other grades is generally well met.

Home business for small bars and light sections is maintained at the improved level of recent weeks, and with the orders they are receiving from abroad, mostly from Commonwealth countries, re-rollers' prospects are much more hopeful.

Demand for the more popular sizes of joists continues to be heavy, but that for angles, etc., has eased. Heavy plates continue to be easier and reasonable delivery dates are now being quoted for approved specifications, but black and galvanized sheets are in short supply, output being covered for several months ahead.

Non-ferrous Metals

The most noteworthy feature of the details issued by the Copper Institute in New York for the month of June was the combined deliveries of refined copper, which amount to 236,600 short tons. Of this total 106,300 tons attached to the United States and 130,300 tons to countries outside the U.S.A. In the States, production of crude copper was 85,100 tons, a gain of 6,900 tons on May, while the output of refined copper at 112,100 tons was 3,700 tons higher than May. Stocks in the U.S.A. declined by 14,000 tons to 68,000 tons. Outside the United States, production of crude copper was 125,500 tons, an increase of 7,100 tons, while the output of refined was some 7,000 tons down at 88,600 tons. Deliveries have already been mentioned, but it may be recorded that outside the U.S.A. there was an increase of 15,100 tons over the May figure. Stocks of copper outside the United States are reported to have fallen during June by 75,000 tons to 180,600 tons. There has been some suggestion that the big increase in deliveries outside the States is due to sales having been made to dealers to an abnormal extent and it will be interesting to see how the July figures turn out.

It is now almost exactly 12 months since trading in copper began again on the Metal Exchange after a shutdown of nearly 14 years, and although adverse criticism has been heard, most people will admit that the market has on the whole done very well. Some changes are forecast, for the standard contract is to be altered to an in-warehouse basis, probably by the end of the year, and it is felt that this may well turn out to be an improvement on the present arrangement of alternative points of delivery. Considering the proximity of the holiday period, last week's trading was fairly active, the turnover in copper being about 5,000 tons. Business came to an end after the midday session on Friday, when nearly 600 tons changed hands. On the week there was a loss of £2 in cash and £1 15s. in three months. Zinc was also down, July by £2 and October by £1 7s. 6d., the contango improving to £1. Lead, too, was weak, second half July and second half October both being marked down by £2 10s. Tin lost £9 10s. for cash and £8 for three months.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* July 29, £234 15s. to £235; July 30, £234 10s. to £234 15s.; August 3, £234 to £234 5s.; August 4, £234 10s. to £234 15s.

Three Months: July 29, £234 5s. to £234 10s.; July 30, £233 15s. to £234; August 3, £233 to £233 5s.; August 4, £233 15s. to £234.

TIN, Standard—*Cash:* July 29, £748 to £749; July 30, £746 to £748; August 3, £744 10s. to £745; August 4, £747 to £749.

Three Months: July 29, £745 to £745 10s.; July 30, £743 to £744; August 3, £740 to £741; August 4, £742 10s. to £743.

ZINC—*July:* July 29, £74 15s. to £75. *August:* July 30, £74 15s. to £75 5s.; August 3, £73 10s. to £73 15s.; August 4, £74 to £74 10s.

Second half October: July 29, £75 12s. 6d. to £75 15s. *First half November:* July 30, £75 15s. to £76; August 3, £74 10s. to £74 12s. 6d.; August 4, £74 15s. to £75.

LEAD—*Second half July:* July 29, £92 15s. to £93 5s.; July 30, £92 5s. to £92 10s. *First half August:* August 3, £92 5s. to £92 10s.; August 4, £93 10s. to £93 15s.

Second half October: July 29, £91 10s. to £91 15s.; July 30, £91 5s. to £91 10s. *First half November:* August 3, £91 to £91 5s.; August 4, £91 to £91 5s.

June Steel Output Record

Steel production in June averaged 371,000 tons a week, which is the highest figure ever recorded for the month of June. Output was slightly below the May rate—which was the highest ever achieved—as the Whitsun holidays affected production in some districts. The weekly average of output over the first half of the year was 366,300 tons, the annual rate being 19,048,000 tons, which was almost 1,000,000 tons higher than the rate in the first half of 1953. Pig-iron production last month reached the highest rate ever achieved of 233,200 tons a week. The June figure was 1,100 tons above the previous record set up in April. Latest steel and pig-iron output figures compare as follow with earlier returns:—

Period.	Pig-iron.		Steel ingots and castings.	
	Weekly average.	Annual rate.	Weekly average.	Annual rate.
	Tons.	Tons.	Tons.	Tons.
1954—May ..	231,400	12,033,000	374,500	19,476,000
June ..	233,200	12,129,000	371,700	19,328,000
Half year	230,100	11,964,000	366,300	19,048,000
1953—May ..	214,700	11,165,000	350,700	18,236,000
June ..	210,600	10,949,000	337,700	17,559,000
Half year	213,500	11,102,000	347,600	18,074,000

PEGLERS, LIMITED—Mr. Albert E. Emberton, vice-chairman and managing director, has been appointed chairman. He succeeds Mr. Albert Ellis, who has retired from the board. Mr. Charles M. Smith has been appointed vice-chairman and Mr. James M. Harrison has been appointed a director.

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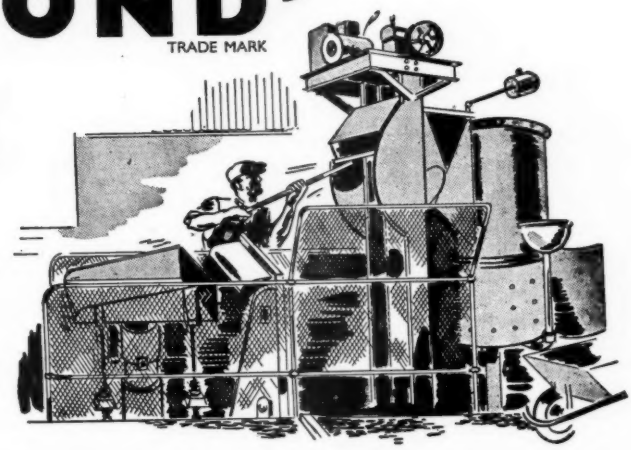

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Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered unless otherwise stated*)

August 4, 1954

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £14 19s. 6d.; Birmingham, £14 12s. 9d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £17 5s. 9d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £17 16s. 9d.

Scotch Iron.—No. 3 foundry, £17 9s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £18 19s. 6d.; South Zone, £19 2s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £19 19s. 6d.; South Zone, £20 2s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £17 14s. 6d.; Scotland (Scotch iron), £18 1s. 0d.; Sheffield, £18 19s. 0d.; Birmingham, £19 6s. 6d.; Wales (Welsh iron), £18 1s. 0d.

Basic Pig-iron.—£15 10s. 6d. all districts.

FERRO-ALLOYS

(*Per ton unless otherwise stated, delivered*)

Ferro-silicon (6-ton lots).—40/55 per cent., £42 0s. 0d., basis 45 per cent. Si, scale 17s. per unit; 70/84 per cent., £65 0s. 0d., basis 75 per cent. Si, scale 18s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. 0d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. 0d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £185 0s. 0d. to £195 0s. 0d. per ton; 38/40 per cent., £251 0s. 0d. to £270 0s. 0d. per ton.

Ferro-tungsten.—80/85 per cent., 14s. 0d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 17s. 0d. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £75 0s. 0d. to £80 0s. 0d., basis 60 per cent. Cr, scale 25s. 0d. per unit; over 6 per cent. C, £74 0s. 0d. to £76 0s. 0d., basis 60 per cent. Cr, scale 24s. 0d. per unit; max. 2 per cent. C, 2s. 0½d. per lb. Cr; max. 1 per cent. C, 2s. 1d. per lb. Cr; max. 0.15 per cent. C, 2s. 2d. per lb. Cr; max. 0.10 per cent. C, 2s. 2½d. per lb. Cr; max. 0.06 per cent. C, 2s. 2½d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 6s. 6½d. to 7s. 1d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £225 0s. 0d. to £232 0s. 0d. per ton; 96/98 per cent., £255 0s. 0d. to £262 0s. 0d. per ton.

Ferro-columbium.—60/75 per cent., Nb + Ta, 52s. 6d. to 70s. 0d. per lb., Nb + Ta.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 12s. 6d.; tested, 0.08 to 0.25 per cent. C, £26 12s. 6d.; hard (0.41 to 0.60 per cent. C), £28 0s. 0d.; silico-manganese, £33 16s. 0d.; free-cutting, £28 16s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £32 12s. 0d.; silico-manganese, £34 17s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 16s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 16s. 0d.; acid, up to 0.25 per cent. C, £33 0s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £31 1s. 6d.; boiler plates (N.-E. Coast), £32 9s. 0d.; floor plates (N.-E. Coast), £32 10s. 6d.; sectional material, N.-E. Coast, £29 4s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £32 7s. 0d.; flats, 5 in. wide and under, £32 7s. 0d.; hoop and strip, £33 9s. 0d.; black sheets, 17/20 g., £42 1s. 0d.; galvanized corrugated sheets, 24 g., £51 8s. 6d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £53 8s. 0d.; nickel-chrome, £75 2s. 0d.; nickel-chrome-molybdenum, £84 13s. 6d.

NON-FERROUS METALS

Copper.—Cash, £234 10s. 0d. to £234 15s. 0d.; three months, £233 15s. 0d. to £234 0s. 0d.; settlement, £234 15s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 27⅞d. per lb.; wire, 268s. 9d. per cwt. basis; 20 s.w.g., 300s. 0d. per cwt.

Tin.—Cash, £747 0s. 0d. to £749 0s. 0d.; three months, £742 10s. 0d. to £743 0s. 0d.; settlement, £749 0s. 0d.

Zinc.—August, £74 0s. 0d. to £74 10s. 0d.; first half November, £74 15s. 0d. to £75 0s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £104 0s. 0d.; rolled zinc (boiler plates), all English destinations, £101 15s. 0d.; zinc oxide (Red Seal), d/d buyers premises, £96 0s. 0d.

Lead (Refined Pig).—First half August, £93 10s. 0d. to £93 15s. 0d.; first half November, £92 5s. 0d. to £92 10s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 22⅞d. per lb.; rods, drawn, 32½d.; sheets to 10 w.g., 259s. 3d. per cwt.; wire, 30½d.; rolled metal, 245s. 6d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £165; B6 (85/15), £208; BS249, £175.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £202; HTB2 (38 tons), £210; HTB3 (48 tons), £220.

Gunmetal.—RCH, 3/4 per cent. tin, —; BS1400, LG2 (85/5/5/5), £198; LG3 (86/7/5/2), £207; G1 (88/10/2/½), £279; (88/10/2/1), £270.

Phosphor Bronze.—BS1400, PB1 (AID released), £290 per ton.

Phosphor Bronze Strip, etc.—Strip, 366s. 0d. per cwt.; sheets to 10 w.g., 388s. 6d. per cwt.; wire, 45⅞d. per lb.; rods, 39¾d.; tubes, 38d.; chill cast bars: solids 40½d., cored 41½d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 1¾d. per lb.; round wire, 10g., in coils (10 per cent.), 3s. 7d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 6d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 3d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex warehouse, £100 0s. 0d. Nickel, £483 0s. 0d. Aluminium, ingots, £156 0s. 0d.; aluminium bronze (BS1400), AB1, £251; AB2, £260. Solder, brazing, BS1845, 1s. 11d. lb.; granulated, 2s. 2d. lb.

Company News

ALFRED HERBERT, LIMITED—The directors propose to increase the capital and make a scrip issue of two for one to ordinary shareholders.

QUALCAST, LIMITED—The group experienced a record year's trading to June 30 in all respects—tonnage, output of finished products, wages paid, and profits, states Mr. V. Jobson, chairman, in a circular to employees.

ELECTRIC FURNACE COMPANY, LIMITED—The directors are increasing the distribution on the £156,500 ordinary capital with a final recommendation of 6½ per cent. to make 10 per cent. for the year ended March 31 last. This compares with a 7 per cent. final to make 12½ per cent. for 1952-1953 on £78,250—prior to the 100 per cent. scrip issue.

SAMUEL OSBORN & COMPANY, LIMITED—The company has obtained control of Low Moor Alloy Steelworks, Limited, Bradford. The works, which with a subsidiary company, produces special iron and high-speed tool steel, stainless and heat-resisting steels, employs about 500 people. Mr. Frank A. Hurst, chairman of Samuel Osborn, and two directors, Mr. C. F. Hurst and Mr. F. A. Martin, who are to act as joint managing directors, have joined the board of Low Moor Alloy Steelworks.

AMALGAMATED METAL CORPORATION, LIMITED—Untaxed group profits contracted from £1,059,464 to £878,402 in the year 1953, but due to lower tax charges, the net profit was £21,094 higher at £364,962. The dividend remains at 8 per cent. for the year on the £4,435,792 ordinary capital. In the full report, Mr. W. Gardner, chairman, says that, generally speaking, 1953 was a year, for non-ferrous metals, of great progress towards a return to traditional and proved methods of trading and that business in this country continued to be good.

MATHER & PLATT, LIMITED—As in previous years the company has declared a 4 per cent. interim dividend on the £2,045,490 ordinary capital for 1954. The £1,363,660 new ordinary shares resulting from a two-for-three scrip issue, approved at last week's extraordinary meeting, will not participate. For 1953 there was a final dividend of 6 per cent. and a bonus of 5 per cent., to make an annual total of 15 per cent. At last week's meeting approval was also given to a proposal to raise the authorized capital from £2,500,000 to £6,000,000.

GLENFIELD & KENNEDY, LIMITED, hydraulic and general engineers, of Kilmarnock (Ayrshire)—The company proposes to proceed with the offer of 395,000 5½ per cent. cumulative preference shares of £1 each at 21s. 6d. per share, to existing preference and ordinary holders registered on May 10. With this issue, the issued preference capital will total £705,000 and it is anticipated that a further £295,000 of preference capital will be issued shortly as consideration for the purchase of certain shares in subsidiaries at present held outside the group, thus making the total preference capital £1,000,000.

BEESTON BOILER COMPANY, LIMITED—A final dividend of 22½ per cent. is announced on the £375,000 ordinary capital for the year to March 31. A 10 per cent. interim was paid on £225,000—prior to the 66⅔ per cent. scrip issue—and with the final now recommended the year's total is equivalent to 28½ per cent. on the present capital. This compares with 42½ per cent. paid for 1952-53 on the old capital which is equal to 25½ per cent. on the present £375,000 ordinary. Profits, before depreciation and tax, total £297,060, against £288,423, while the net figure of £107,088 compares with £99,862 previously.

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YOUNG FOUNDRY MANAGER (33), well educated, keen and energetic, technically trained by well-known firm, City and Guilds, A.I.D. radiologist, successful practical experience starting prosperous grey iron and non-ferrous jobbing foundry, floor, plate, machine moulding, estimating, costing, buying, customer liaison, etc., used full control, seeks progressive situation.—Box YF652, FOUNDRY TRADE JOURNAL.

REPRESENTATION required by experienced and fully trained Foundryman, to cover the Southern half of England. Thorough practical and technical knowledge of trade. Capable of working on own account. Interested in foundry supplies, metals, ferrous and non-ferrous, Machinery, and general equipment.—Box RR610, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN/MANAGER desires change. Life experience trade Practical and Technical; grey iron jobbing, marine, machine tool, and general engineering castings. Accustomed take full control. Moderate salary/results bonus. Box FF666, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER, 49. Life experience, ferrous and non-ferrous. Vast practical and technical experience; developments, materials, modern technique. Foundry finance. 14 years managerial, desires change, preferably complete charge of medium or small foundry. Box FM665, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 *inclusive or a woman aged* 18-59 *inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order,* 1952.

SKILLED NON-FERROUS MOULDER required. High-class light and medium sand work. Permanent post in old-established business. 5-day week.—Further details apply DANIEL YOUNG, LTD., Witney, Oxon.

METALLURGIST required for Malleable Iron Foundry (Blackheart) in the Yorkshire area. Applicant should have had experience in a similar position.—Please give full particulars of past experience and present position, which will be treated in strict confidence, to Box MR659, FOUNDRY TRADE JOURNAL.

SALES OFFICE ESTIMATOR required for Steelfoundry.—Apply in writing, giving full details of experience, etc., Box SO621, FOUNDRY TRADE JOURNAL.

TECHNICAL Sales Representative for the sale and servicing of Shell Moulding Equipment in the Midlands area. Age about 30, well educated and with pleasant sales personality, preferably with good foundry background. Please state in confidence fullest possible details of education, experience, etc. Our staff have been notified of this appointment. Box TS674, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*contd.*

WORKS ENGINEER required for expanding Foundry in Glasgow area. Must be experienced in the design and layout of foundry plant, and capable of taking general control of maintenance. This is a permanent position, and will carry membership of a superannuation scheme.—Particulars of experience and present salary in confidence to Box WE645, FOUNDRY TRADE JOURNAL.

APPLICATIONS invited from fully skilled IRON AND NON-FERROUS MOULDERS for a Foundry on the South Coast. Good basic pay with pension and profit sharing schemes in operation.—Write, giving full details, to Box AI644, FOUNDRY TRADE JOURNAL.

SALES OFFICE ESTIMATOR required for Steelfoundry.—Apply in writing, giving full details of experience, etc., Box SO643, FOUNDRY TRADE JOURNAL.

METALLURGICAL CHEMIST for well equipped foundry and laboratory engaged on interesting development work, coupled with high class foundry production. Should have H.N.C. or similar and some ferrous experience. Excellent opportunity for young man to gain valuable knowledge and experience in progressive post. South-West Birmingham. State age, experience, salary, etc.—Box MC656, FOUNDRY TRADE JOURNAL.

MECHANIC required, with experience of "B.M.M." moulding machines, to service an installation of 32 Turnover and Straight draw type machines in a South African Foundry.—Replies to Box MR614, FOUNDRY TRADE JOURNAL.

METALLURGIST, to control melting, sand and annealing at Blackheart Malleable Iron Foundry in Midlands. Must be capable of producing the highest quality iron and have progressive ideas.—Apply, stating age, experience, and salary required, to Box MT653, FOUNDRY TRADE JOURNAL.

GRAVITY DIE FOUNDRY (Aluminium) in Midlands requires SHOP MANAGER. Must be practical man, capable of taking full charge of labour and production; age 30/40. Four-figure salary for the right man.—Box GD616, FOUNDRY TRADE JOURNAL.

JOBBING MOULDERS required, London shop; also CUPOLA FURNACEMAN.—Apply PLANT, MACHINERY & ACCESSORIES, LTD., 136/140, Bramley Road, W.10.

FOREMAN.—Non-ferrous and Ferrous foundry in the West Country, for Architectural, Statutory, and General Engineering Castings up to 2 tons. Applicants should have had good technical training, also practical experience, including estimating. State full details.—Box FN 648, FOUNDRY TRADE JOURNAL.

FOUNDRY METALLURGIST required for West Midlands. Must have sound experience of High Duty Iron, and it would be advantageous to have some knowledge of Malleable Iron.—Box FR657, FOUNDRY TRADE JOURNAL.

UNIVERSAL MILLERS for Birmingham and Manchester. First-class men, used to high-class work to dead-on limits. Excellent conditions and highest possible remuneration. Particularly accustomed to handling latest and largest Huron, Cincinnati and similar universal milling machines.—Write full particulars of experience to WRIGHT & PLATT, LTD., the world's largest engineering master pattern-makers, Irving Street, Birmingham, 15.

SITUATIONS VACANT—*contd.*

FOUNDRY METALLURGIST for Automobile Foundry to assist in controlling of metal, sand, etc. Dudley Area. State age, experience and salary required. Box FM672, FOUNDRY TRADE JOURNAL.

FOUNDRY SUPERINTENDENT for small non-ferrous and aluminium Foundry (Nottingham) producing high quality sand castings. Must be adaptable, have sound technical knowledge and capable of taking full charge. State age, experience, fully &c. Box FS671, FOUNDRY TRADE JOURNAL.

FOREMAN PATTERNMAKER required for Midlands. Must be first class wood and metal man, able to estimate and check, and to control labour. Good technical and general education. Permanent position for suitable applicant. State age, salary at present received and required, and full details of experience. Box FP670, FOUNDRY TRADE JOURNAL.

A TECHNICAL REPRESENTATIVE is required by Bagshawe & Company Limited, Dunstable Works, Dunstable, to handle sales of malleable iron castings. Previous experience of foundry sales and/or some practical foundry experience will be an advantage. Applications, which will be treated in confidence, must state full details of experience and salary required.

TECHNICAL ASSISTANT.—An expanding Foundry in the North-East, producing Non-ferrous (principally Aluminium Alloy) sand, shell, and gravity die castings, has a vacancy for a Technical Assistant, with sound Foundry Drawing experience, educated to H.N.C. standard, and preferably with some foundry experience. Salary according to ability and previous experience, with excellent prospects of promotion to Foundry Manager. Housing assistance if required.—Reply, giving full details of career to date, age, etc., to:—MANAGING DIRECTOR, Daralum Castings, Ltd., Longfield Road, Darlington.

PATTERNMAKERS, experienced in both wood and metal, wanted in Birmingham and Manchester by the world's largest engineering master patternmakers. Must be accustomed to highest standards and accuracy, and prepared to work overtime. Ideal conditions, top remuneration.—Write full particulars of experience to Head Office, WRIGHT & PLATT, LTD., Irving Street, Birmingham, 15.

FOUNDRY MANAGER required with sound Metallurgical knowledge. Applicants having good Foundry experience only will be considered This position offers first class opportunities to men with initiative and drive. Apply in writing, giving particulars and salary required to Box FM667, FOUNDRY TRADE JOURNAL.

DIE DESIGNER required for Investment Castings Foundry. Applicants should have design experience of pressure injection dies. Previous experience in Investment Castings desirable but not essential. Please write in confidence, stating age and giving full details of previous experience to The Personnel Officer, The de Havilland Engine Co. Ltd., Stag Lane, Edgware, Middlesex.

FOREMAN to take complete control Non-ferrous Foundry in Yorkshire. Knowledge copper and white metals. Complement 30 men. Replies to Box FT668, FOUNDRY TRADE JOURNAL.

SKILLED NON-FERROUS MOULDERS required. Light and medium, dry and green sand-work. Top rates of pay and piecework. Permanent employment with an old-established firm in Yorkshire Accommodation found for single men.—Write Box 9906, C.P.P., 35, Morley Street, Bradford.